IMMANUEL VELIKOVSKY

Worlds in Collision

Paradigma

THE VELIKOVSKY HERESIES

Worlds in Collision and Ancient Catastrophes Revisited

LAIRD SCRANTON

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INTRODUCTION

THE IRREPRESSIBLE OUTSIDER

The long-persisting controversy over the unorthodox theories of Immanuel Velikovsky is one that I first became acquainted with during my years as a college student in the early 1970s. Although I earned my degree in English in Poughkeepsie, New York, as one of the early male co-eds at Vassar College, my off-school breaks were largely spent with my family in Portland, Oregon, a lovely city in the Willamette Valley, where I had attended high school. Portland is an intelligent, liberal-minded community with an active curiosity for new ideas and a well-earned reputation for thinking "outside the box." During my college years, Portland was home to *Pensée* magazine, a student-run publication that had been produced to "encourage continuing critical analysis of all questions raised by [Immanuel] Velikovsky's work."[1] In those days, a person could not walk through the vibrant downtown of the city of Portland without passing by at least one street-side stand that displayed a copy of *Pensée* magazine. In retrospect, it seems hardly possible to have been a twenty-something student in that place and at that time without gaining at least a passing familiarity with the controversy that surrounded Immanuel Velikovsky.

Two decades later, during the mid-1990s, as the most time-intensive demands of my profession and of parenting began to ease, I found moments once again to read for personal pleasure, and my interest in unresolved mysteries brought me back again to Immanuel Velikovsky. I was now able to acquire and familiarize myself with many of his works, beginning with his books *Worlds in Collision* and *Ages in Chaos.* I also read with growing interest the arguments of various reputable critics of Velikovsky, along with a number of other books that were devoted to a more general discussion of the Velikovsky controversy itself.

Fairly quickly I came to see that the role Velikovsky had attained in relation to the scientific community—essentially that of a heretic's heretic—

seemed to have come about largely because of differences in the methodology he applied to his studies, as compared with those typically employed by a professional historian or scientific researcher. Velikovsky's approach was often difficult for a traditional academic to accept—or sometimes even to fully understand—and so became one source of apparent frustration for some academics as the controversy played out. In some ways, Velikovsky became to traditional scientists in the 1950s what Groucho Marx had been to the social elite of the 1930s—the irrepressible outsider who, while steadfastly refusing to play by traditional rules, still threatened to beat an entrenched elite at their own game, with the potential to make them look ridiculous in the process.

It is fair to say that Immanuel Velikovsky approached his subject matter in a novel way and applied a unique brand of ample intelligence to many of the problems he researched. It was Velikovsky who, with straight-faced chutzpah, offered up ancient mythological storylines as evidence to support a controversial new astronomic theory. Velikovsky was the person who unblushingly put forth rational scientific explanations for biblical events that others had long since dismissed as unfathomable miracles—events that, for many, might properly fall somewhere closer to the realm of fairy tales than serious scientific discourse.

His theories touched on many different subject areas, and the implications of those theories often asserted themselves—without regard to traditional pedagogical boundaries—across a wide range of academic disciplines. One way to characterize the kind of brash unexpectedness with which Velikovsky's unorthodox methods presented themselves to the scientific community of the 1950s would be to compare them to the acts of a later fictional movie hero named Indiana Jones—the swashbuckling, whip-carrying archeologist who, when faced with the losing prospect of a scimitar fight against an overmatched opponent, makes the inspired choice to go against type, pulls a gun from his belt, and simply shoots the inconvenient interloper.

It is perhaps this unusual methodology that resonates most with Velikovsky's audience—his innate ability to infer from a small initial set of discrete facts a much broader set of patterns and implications that had remained largely undiscerned by his more traditional peers. It is this same

unorthodox methodology that seems to have most inflamed his detractors, who never quite knew what to do with an opponent who refused to play by their rules. The dynamic between Velikovsky and the scientific community reminds me of a time early in my relationship with my wife, Risa, when we would often spend a pleasant evening playing the card game bridge with various friends.

Bridge is a game of skill that is often conducted by serious players according to a system of complicated rules. Each round of play is preceded by a prerequisite round of bidding, and when executed properly, each bid carries with it levels of meaning that may not be immediately obvious to the unsophisticated observer. Nonetheless, for a serious bridge player, these bids often imply to his or her partner information about the number of face cards and the relative strength of various suits that exist in the bidder's hand. Risa and I, on the other hand, had always adopted a very straightforward, aboveboard approach to the game, in which a "one-spade" bid simply implied that one of us believed that we could negotiate a contract of one trick above "book," with the suit of spades declared as trump. This approach, which worked quite well for our purposes, had a way of wreaking havoc with the sensibilities of the other players around us, whose impulse was to look for deeper symbolism in our bids.

Another reason for my interest in Velikovsky's unorthodox methodology is that it resonates with my own professional mind-set. As an independent software designer and troubleshooter, my job typically requires me to analyze some aspect of a client company's complex, mission-critical business software, then—typically on a short timeframe—make a significant change to it. Early in my career I began to notice a disturbing trend in the projects I was hired to do—that each one seemed to require me to know more and more about a client's often unique software, but with less and less outside help or reliable guidance. I joked with myself that, if the trend continued, I would eventually be required to know *everything* about a client's system with *no* outside assistance whatsoever. In order to accomplish this and without the luxury of sufficient time to learn all the critical aspects of the system I was about to modify, I needed to develop analytical techniques that would, on the basis of a small number of known facts and a broad overview of how business software typically works, point me in the right direction to make my

changes. I think of these techniques as ways of "knowing without knowing," and I can see similar techniques at work in Velikovsky's methodology.

For me, there is a fundamental difference between the way a programmer and a scientist looks at the world. For most scientists, a 5-percent chance that a theory could be wrong is sufficient reason to cast doubt on the approach, while for me as a programmer, a 60-percent likelihood that a theory is right can often be ample reason to actively pursue it. While a good scientist typically works forward through a complicated theory in incremental steps, each based on carefully quantified facts, I tend to begin with a set of core facts or observations and move forward from these in much larger steps, making some choices based on approximation, probability, and inference.

This difference in approach is well illustrated by a technique that was suggested to me as a grade-school student when I was first introduced to a dictionary as a research tool. If you want to look up the dictionary entry for the word *flicker*, you could start by leafing through the book from front to back until you come to words beginning with "F," then continue forward a page at a time until you eventually find the word *flicker*. On the other hand, you could choose to begin at the "F" tab of the dictionary, then, estimating that words beginning with "Fl" will likely fall somewhere beyond a third of the way into the "F" section, continue your search partway through that section, moving forward or backward in increments until you find the entry. Either approach will ultimately bring you to the correct page, but for me, the second approach represents a much more effective way of getting there.

This method is similar to a programming technique called a binary search, in which a programmer divides a set of sorted searchable material in two, disregards the half that he knows does *not* contain his entry, then continues the search using only the remaining half, which he again divides in two. The technique allows a computer program to locate one specific record (out of perhaps millions of records) with only a very small number of actual inquiries.

Another difference in methodology between a typical scientist's and Velikovsky's approaches to science is found in the way that known facts are seen to relate to one another. For example, a scientist given the value *pi* and the radius of a circle will quickly realize that he can derive other useful information from those initial facts, such as the circumference of the circle.

However, when faced with two different contemporaneous ancient cultures from different regions of the globe who are known to have made the very same extraordinary claim about the unusual appearance of the planet Venus, these same scientists somehow fail to notice that important additional information can also be derived from the mere concurrence of those statements, namely, that *something unusual* must certainly have been happening to Venus in ancient times in order to have precipitated the matching reports.

One longstanding complaint I have with modern scientific discourse in general as it pertains to unorthodox theories such as Velikovsky's involves the concept of *coincidence.* Meaningless coincidences can be a professional hazard for any theorist—orthodox or heretical—and the ability to distinguish between the meaningful interrelationship of two events and the less meaningful coincidence of two disconnected events becomes an important skill.

My complaint comes in response to an apparent double standard that often seems to be applied when evaluating unorthodox theories. For example, there would likely be little tolerance from traditional astronomers if I were to argue that single-star systems must actually be the rule in the universe and that the preponderance of binary star systems must be a mere coincidence; clearly there are far too many counterexamples to justify my view. I would expect even less tolerance if the validity of my theory depended on two or more coincidences.

For me, a good rule of thumb has always been that the need to invoke two levels of compounding coincidence is usually enough to disqualify a theory from consideration. However, in cases like the Velikovsky controversy, in which a growing number of predictive aspects of his theory have seemingly proved to be correct over the course of several decades, traditional astronomers seem to have developed an unreasonably high tolerance for coincidence as a theory of last recourse by which to explain them away.

Another aspect of Velikovsky's theory that, for me, ultimately works in his favor is the sheer tenacity with which certain key aspects of the theory have resisted outright disproof. The state of science being what it is today, one would think that it should be a do-able task to categorically refute a theory that has been as widely critiqued and derided as Velikovsky's. From the

standpoint of traditional astronomers, there are at least a dozen points at which Velikovsky's theory might potentially be shown to be flatly wrong (many would say that his theory has long since been flatly disproved), yet over time, as new facts emerge, these points take on new life as subtle aspects of the theory continue to be shown to be ultimately valid. To my way of thinking, surely this kind of persistency is one hallmark of a theory that is worthy of careful reconsideration.

Sadly, but in seeming fulfillment of prophesies made by George Orwell in his classic book *1984,* I have seen several instances, even over the relatively brief course of my research, in which online articles I cite have since been altered, sometimes with references to Velikovsky removed or information pertinent to his theories altered. However—the Brave New electronic era notwithstanding—the principle has always been that, once published, an author's text is fair game for quoting by others. This holds true historically even for texts that have since passed out of existence, such as certain ancient Greek texts, which we can now only quote secondhand based on references from some other Greek author. What this means (as with all online postings) is that the reader should be aware that some Internet references may have changed (or perhaps even been outright removed) since they were originally quoted. In the name of a rapidly failing ethic of intellectual integrity and cultural sanity, I steadfastly affirm that any statement included here has been fairly and accurately quoted from the Internet articles cited, as they appeared at the time of quoting.

1

WORLDS IN COLLISION AND THE FIRESTORM IT CREATED

In 1950, a Russian-born psychoanalyst named Immanuel Velikovsky published a wildly popular, hugely controversial book called *Worlds in Collision.* Even before its release, public reaction to various promotional summaries and early critical reviews assured that the book, in which Velikovsky proposed that there had been great planetary upheaval within our solar system during historical times, was likely to foment a firestorm of controversy among the scientific community.

Although Immanuel Velikovsky had no credentials as a trained astronomer, his academic background, reputation, political associations, and professional standing were such that the scientific community could not realistically afford to simply ignore his book. He had become Israel's first practicing psychiatrist and psychotherapist and was trained by Sigmund Freud's famous pupil Wilhelm Stekel. Some of Velikovsky's writings appeared in Freud‘s psychoanalytic journal *Imago.* In Berlin, while taking postgraduate courses in the early 1920s, Velikovsky founded and edited the journal *Scripta Universitatis*, on which he sometimes worked in collaboration with Albert Einstein, who prepared a section of the publication that pertained to physics and mathematics. There he also met and married violinist Elisheva Kramer, with whom he would have two daughters. In 1930, Velikovsky published the first paper to suggest that epilepsy might be diagnosed based on abnormal encephalograms. Later, Velikovsky also worked diligently, along with Einstein and Dr. Chaim Weizmann, to establish the Hebrew University in Jerusalem.

In 1939, on the winds of impending war, Velikovsky moved with his family to New York City (an intermediate stop on their way to Princeton, New Jersey, which would also become an eventual home for Einstein), intending to spend a sabbatical year researching his book *Oedipus and*

Akhnaton. While in the process of conducting this research, Velikovsky came upon ancient Egyptian texts (such as a papyrus containing a poem called "The Admonitions of Ipuwer") whose references to a great catastrophe in Egypt recalled a time when the rivers ran red and fires blazed in the sky and seemed to provide an historical basis for events described in the biblical book of Exodus, when Moses and the Israelites left Egypt at the time of the Ten Plagues. Velikovsky's interest in this material ultimately stole his attention, caused him to stray from his intended project, and led him instead to focus on research that ultimately produced *Worlds in Collision.*

Velikovsky's manuscript for *Worlds in Collision* was submitted to and rejected by eight different publishing houses before it was ultimately accepted and published by Macmillan and Company in 1950. As early reviews of the book came to suggest, soon after publication *Worlds in Collision* became the catalyst for a fierce intellectual debate—one as intense as any in recent memory. The debate pitted an entrenched scientific orthodoxy against an upstart theorist and was carried out with a kind of ferocity the world had seldom seen since 1610, when the Catholic Church prosecuted Galileo for challenging the then-prevailing Earth-centered concept of the solar system.

Perhaps the first point of upset for many scientists regarding *Worlds in Collision* was that a nonscientist—a doctor of psychiatry who had also developed an abiding interest in ancient studies—could have the sheer audacity to offer obscure references from ancient myths and texts as serious evidence to support what most considered to be a radical astronomic theory. Velikovsky's sources, which seemed clearly unorthodox when offered as evidence in an astronomic setting, were not only unfamiliar to most of these scientists, but also were largely seen by them as having little more scientific validity than a child's fairy tale. Nor did it help Velikovsky's case that he expressed views in his book that ran directly counter to the conventional scientific wisdom of the day. Moreover, many of the predictive statements (or as Velikovsky preferred to call them, *"advance claims"* or *"prognostications"*) that Velikovsky cited as logical consequences of his theory were deemed by traditional scientists to be flatly impossible.

We might rationalize some of the intensity of the scientists' reactions to the book if we consider the professional stakes that seemed to be at risk for these

scientists, some of whose careers might well have hung in the balance of the controversy. As many of them must have known, the ultimate outcome of the debate rested largely on the degree to which a much less scientifically aware public might eventually come to embrace or reject Velikovsky's theories. No doubt some scientists felt that if Velikovsky's book were to somehow gain broad popular acceptance, then many of the bedrock assumptions of modern astronomy might come into question. From this perspective, the book could be seen as both a highly embarrassing public slap in the face to the astronomic community and as an outsider's potentially damaging challenge to then-established astronomic theory.

Another likely reason for the intensity of the reaction to *Worlds in Collision* was that the book committed what amounted to an inexcusable faux pas in 1950: both its thesis and its author brazenly dared to cross the invisible boundaries that are traditionally observed between a number of different academic disciplines. In doing so, Velikovsky may have thrown many scholars within those disciplines off balance by essentially challenging many of their key assumptions on the basis of evidence that was drawn from fields other than their own. Astronomers of the day were not accustomed to having to give account for themselves or their theories to historians. Nor were they inclined to accept fragmentary testimony or ancient references that had been obscured by the sands of time and framed in some archaic language on the same footing as traditional empirical scientific evidence. Consequently, few may have known quite how to respond to what they saw as an unorthodox attack on their field of study or felt up to the more challenging task of trying to definitively refute Velikovsky's broader theory, portions of which may have fallen outside of their own field.

In *Worlds in Collision* at its simplest, Velikovsky posited—based on statements and observations extracted from written texts, myths, words, and engraved artifacts of ancient cultures from around the globe—that, contrary to prevailing scientific belief, the planet Venus (which is thought by traditional scientists to be billions of years old) must be a relatively recent addition to our family of planets. Furthermore, he proposed that Venus had made its first appearance in our solar system a mere 3,500 years ago—around 1500 BCE—and then behaved not as we would expect a planet to behave, but rather like a brilliant comet. Venus was described by several ancient cultures

as having a long “tail” or “beard” and was said to have brightened the entire heavens, moving erratically across the sky and creating havoc for centuries prior to settling down into its familiar role as one of the most orderly planets in the solar system. Furthermore, it was Velikovsky’s personal contention that the movements of this comet could explain—and might ultimately provide an historical basis for—many of the seemingly miraculous events of the Bible, reported to have occurred at the time of the Exodus of the Israelites from Egypt. No wonder that this would seem to the average scientist of the day as a frontal assault on science and as a wholesale attempt to reassert what he or she saw as an outmoded religious paradigm, one that the scientific community had worked diligently for decades or even centuries to supplant.

From the perspective of many of the scientists, Velikovsky’s book threatened to resurrect a brand of catastrophism that had long since gone out of style, one that had dominated religious and scientific thought for many generations beginning in ancient times and had continued through the mid-nineteenth century. This era of the dominance of religion ended in 1859 at the time of the publication of Charles Darwin’s *On the Origin of Species.* With Darwin’s book, the idea that our universe could be a place of recurring catastrophes (a belief that had become associated with the old-time religions and was characterized by the term *fire and brimstone*) was abruptly superseded by the then new theory of evolution, which required long eons of uninterrupted uniformity in order to accomplish its almost imperceptibly slow, deliberate work.

From this same perspective, Velikovsky’s theory could also be seen by traditional scientists as a threat to *uniformitarianism,* a principle that was required to support Darwin’s theory of evolution. The uniformitarian view presumes that the natural laws and processes that can be seen to operate in the universe today have always operated in the universe in the past and can be presumed to apply everywhere in the universe. The concept effectively holds that all things continue as they were from the beginning of the world, and it is contradicted by the unsettling notion of a solar system that might still be under threat of potential upheaval.

Perhaps even more crucial to the modern scientific outlook fostered by Darwinism is the idea of *progress;* in fact, my good friend Egyptologist John Anthony West often disparagingly refers to modern science as *the Church of*

Progress. By this he means that modern science, which he feels has come to be nearly as dogmatic in modern times as the Catholic Church was in the days of Galileo, is predicated on a long history of sustained growth in human knowledge and capability. This growth of progress is imagined to have begun at a very crude state sometime in remote antiquity and to have slowly but persistently improved, right up until the present moment. Within this mind-set, it is reasonable to think of each generation as being somewhat more advanced and capable than the one that preceded it. Also inherent in this view is the unspoken assurance that ours—the most recent generation—must therefore also be the most knowledgeable, technologically advanced, and capable one ever known in the history of the planet.

Since the publication of *Worlds in Collision,* many articles and books have been written about the controversy it engendered. These include detailed analyses of the fierce debate within the scientific community over Velikovsky's proposed scenario for the birth of Venus, about the scientific feasibility of the sometimes astonishing motions and behaviors of the various astronomic bodies he describes, and about the specific predictive outcomes he cites as points for the eventual validation of his argument. C. Leroy Ellenberger, a one-time supporter and later vocal critic of Velikovsky's theories, wrote in a 1986 letter[*1] to the *Skeptical Enquirer* journal titled "A Lesson from Velikovsky," "The less one knows about science, the more plausible Velikovsky's scenario appears, especially when most of the discussion is hand-waving."[1]

Writer and editor Eric Larrabee made the following conclusions in a 1963 article for *Harper's Magazine* titled "Scientists in Collision: Was Velikovsky Right?" "Velikovsky's theory is overpoweringly unorthodox. It is simply too much to take. Only someone who is willing to carry open-mindedness beyond the average limits of scholarly practice is likely to give it a moment's consideration, and only someone who can brook the massed disdain and scorn of Academia can afford to give it public support."[2]

Astronomer and skeptic-at-large Philip Plait has argued steadfastly against the propositions raised by Velikovsky in *Worlds in Collision.* He states in an online blog regarding Velikovsky, "I wrote a chapter in my book about V[elikovsky]'s theories, and could easily have written a whole book on just his terrible astronomy claims. I can't remember a single thing V[elikovsky]

said in his book “Worlds in Collision” that was astronomically correct. It’s an astonishing collection of rampant wrongness.[3]

Other critics of Velikovsky, such as astronomer J. Derral Mulholland, took a more evenhanded approach, both to Velikovsky and to his subject matter. He writes in *Scientists Confront Velikovsky:*

> If it is the function of science to explain man’s relation to his universe, then these are questions of serious significance and should be dealt with seriously. Velikovsky’s challenge is not one to be decided on a basis of belief or unbelief. He does not say, “Trust me”; he says, “This conclusion is suggested by the observations.” He strives, it seems to me, to build physically plausible solutions that involve testable ideas. He is not a mystic. He doesn’t use little green men with three ears; he uses real planets. It is not sufficient to reply that his ideas are absurd: there are too many examples of absurd ideas come true.
>
> Are the explanations plausible? From at least one vantage point, yes indeed. *If* a planet-sized object were to pass close by the Earth, then giant tides would be raised; there would be global earthquakes; the north pole would change direction; the day, the month, the seasons, the year would all change. Faith is not involved here; these are unavoidable consequences of the laws of motion as we presently know them. We must accept that the dynamical aspects of Velikovsky’s visions of hell on Earth are largely acceptable. This is not to admit that the events he described ever happened, for there remain three questions that need to be resolved. Does our knowledge of the laws of motion permit or deny the possibility of encounters between the known planets? Are Velikovsky’s interpretations of certain information the best available ones? Are there uncited observational data that confirm or refute the hypothesis of repeated cosmic catastrophe?[4]

It is with Mulholland’s spirit of generosity and Ellenberger, Larrabee, and Plait’s clear statements of caution firmly in mind that we state our purpose in writing this book. Because the causative relationship Velikovsky assigns to Venus as the likely agent for various biblical miracles has no direct bearing on these unresolved astronomic questions, let us be clear from the outset that it is *not* our intention here to reexamine or reevaluate many of Velikovsky’s

biblical claims.

Rather, we will take another look at the remarkable Velikovsky controversy from the fresh perspective of a new century, highlight many of the unanswered scientific questions on which various aspects of the controversy still turn, and reexamine some of the predictive implications of Velikovsky's theories in the light of the many recent scientific findings that relate to Jupiter, Mars, Venus, the moon, and the study of comets. Our purpose is not necessarily to offer up definitive proof for or against Velikovsky's much-embattled theories, but rather to ask the more general question of whether—and in what ways—recent findings might be seen to uphold or refute Velikovsky's controversial viewpoint.

I propose to revisit many of the most controversial aspects of Immanuel Velikovsky's *Worlds in Collision* theory, this time from the perspective of science that is nearly a half-century more mature than when Velikovsky was last able to personally defend it. In the decades that have followed his death, I for one, have watched with eager anticipation every new scientific announcement relating to Venus, Mars, Jupiter, or the formation of the planets or comets, wondering each time whether this new announcement could be the one that would finally put to rest a longstanding controversy. Now, in the immediate wake of recent scientific projects such as the European Space Agency's Venus Express probe, seems like an opportune moment to reacquaint ourselves with the work of Immanuel Velikovsky, review his personal history, and reconsider the salient details of a theory that, in its day, inspired such controversy as to turn the entire astronomic world on its head.

2

VELIKOVSKY’S THESIS

It is well known that Immanuel Velikovsky notoriously disliked summaries or condensations of his books; he felt that many of the persistent complaints against his theories grew out of misunderstandings that had been fostered by such summaries. Knowing this, we might ask the serious reader who is not yet familiar with Velikovsky’s work to pause at this point long enough to acquire and familiarize themselves with a copy of *Worlds in Collision.* However, for those others of us who may have less time and energy to devote to the subject—and notwithstanding Velikovsky’s own personal preferences—it seems to only make sense, with apologies, to preface this study with a brief review of the controversial scenario that lay at the heart of *Worlds in Collision*.

Before we begin, we should point out that there is scarcely any aspect of Velikovsky’s original thesis that has not already been hotly and vigorously debated, critiqued, amplified, reviewed, and/or defended in numerous articles and books, often with accompanying charts and graphs. Much that has been written about Velikovsky by members of the scientific community has taken a rather harshly dismissive tone. It is not our purpose here to reanimate these debates or to add fuel to their fire except through the citation of new evidence that may be seen to have specific bearing. Our intent is to simply offer up in organized form many of the key points of Velikovsky’s thesis, then address aspects of those that could be potentially amplified or clarified by recent findings. As a general guideline, for each major stage of Velikovsky’s scenario we will be asking two questions:

1. Can the evidence that has been uncovered in recent years be seen to uphold or contradict this aspect of Velikovsky’s theory?
2. Is there a reasonable perspective from which this aspect of Velikovsky’s theory could be possible?

We should also mention that date estimates for various events that occurred

in ancient times have gone through revisions based on radiometric dating techniques (and caveats to those techniques) that have come into use since 1950. Consequently, the eruption of Thera, which Velikovsky places at the middle of the second millennium BCE (approximately 1500 BCE), is now more conventionally dated to around 1610 BCE. However, this eruption still corresponds to the approximate end of the Middle Kingdom in Egypt, which Velikovsky also correlates to the same eruption. Likewise, most radiometric dates involve some imprecision and so are often give in terms of an estimated date range. Consequently, the reader should be aware that there could be some confusion in this discussion when attempting to compare dates cited by Velikovsky to those given in more recent studies, which are based on a revised chronology. Because the relationship of various historical events to one another has not changed, for the purposes of this study we can treat the dates as relative markers and focus instead on the actual time frames involved.

Following Velikovsky's observation that details from the Egyptian *Papyrus Ipuwer* might provide historical support for the seemingly miraculous events reported in the book of Exodus, he began to examine other writings from the same historical era and of other contemporaneous ancient cultures, looking for similar reports. These would include mention of any unusual movements of the sun or stars, of a time when the earth shook violently, when the world suffered a prolonged period of darkness or sunlight, when fire or stones rained from the sky, when rivers were said to have turned red, or when flood tides rose and/or receded unexpectedly. He explored other Egyptian, Hebrew, and Greek texts, Babylonian and Assyrian clay tablets, ancient Vedic poems from India, classic Chinese epics, and myths and legends from Peru, Brazil, Central America, and North America (as far north as the realm of the Eskimos) looking for reports of similarly odd events. He found what could be reasonably interpreted as corroborating evidence of a worldwide cataclysmic event, during which the "land turned upside down" and "north became south."[1] These were accompanied by widespread reports of changes in the movements of the heavenly bodies, including specific recollections of a time when the sun was reported to have "set where it formerly rose." According to Velikovsky, the *Papyrus Ipuwer* states that "the earth turned over like a potter's wheel."[2] In his chapter "East and West" in *Worlds in Collision*,

Velikovsky cites a very long list of references, drawn from ancient cultures from all regions of the world, that include details of calamities that bear outward resemblance to events described in the book of Exodus.

On the basis of this body of ancient testimony, taken from many different sources, Velikovsky theorized that the pattern of worldwide disruption described in the ancient texts might make historical sense if he posited that the earth had suffered the close approach of another terrestrial body large enough to have perturbed the orientation of its axis. This theoretic “tipping” of the planet could provide a rational explanation for reported changes in the position of the sunrise and could account for legends in which the sky or stars “fell” or the sun “stood still” for a period of time. However, Velikovsky noted that the various lamentations about the reversal of the sun did not all date from a single time period, but were in fact often separated from each other in time by several centuries.[3] Furthermore, some of the very oldest cultures, such as ancient Egypt and China, were home to legends in which the sun was said to have reversed its position on several different occasions—rising first in the east, then in the west, then in the east again—all within the span of their own societal memory.

Having settled on a scenario that could theoretically explain the ancient reports of disruptions, Velikovsky then began to search for an agent capable of having inflicted such disruptions. He again surmised, based his own knowledge of astronomy and on descriptions given in various ancient texts, that the most likely type of astronomic body to have been responsible for these events would have been a comet. This supposition was supported by reports, such as those from ancient Mexico, in which multiple episodes of destruction were described as having occurred on a fifty-two-year cycle. Velikovsky knew that periodic recurrence is typical of comets, which orbit the sun time and again in great ellipses that can return them back to the vicinity of the sun on regular cycles. The same Mexican records that offered Velikovsky the clearest outline for a sequence of successive occurrences of global upheaval also assigned that tumult to a comet-like agent called Quetzalcoatl. According to legend, this comet first gave the appearance of a snake-like monster, but eventually transformed itself into a “star.” Velikovsky noted—with some confusion—that the title Quetzalcoatl was also a name that had been traditionally assigned by these same cultures to the

planet Venus. This observation was supported by the names or descriptions apparently given to the same comet in other cultures (the smoking star in Mexico, the long-haired star in Peru, and the Babylonian torch star or bearded star, along with the more general morning star), which Velikovsky came to learn had also been later applied to the planet Venus.

The discovery of a nominative association between the disruptive comet and the planet Venus set Velikovsky on a kind of personal quest to exhaustively explore the earliest references to Venus as they were given in various ancient cultures. He found that he was unable to uncover any references that unequivocally described Venus as a planet prior to around 1500 BCE. (He did find pre-1500 BCE references to goddesses such as Inanna who were associated with the planet Venus, but their iconography was that of a comet.) Likewise, virtually every ancient culture that Velikovsky studied had once documented a four-planet system, one that curiously included only Jupiter, Saturn, Mars, and Mercury. Moreover, the very earliest references to Venus in many of these same cultures often defined it using terms typically reserved for comets. They described Venus as exhibiting appearances and behaviors that were distinctly unlike those of any planet we currently know. For example, Venus was described as being “hairy,” with a “tail,” “horns,” or a “beard”—terms that were typically used to describe the trailing vapor tail of a comet. In some instances Venus was reported to “smoke” as it moved erratically across the sky. Likewise, it was said to rival the sun in brilliance, a characteristic that could never be sensibly applied to the planet Venus as we know it today. Many rated its brilliance on a par with that of the sun and the moon, and grouped it in a kind of triad or trinity with the sun and the moon based on their great brightness relative to the stars.

Velikovsky cites case after case in which the earliest societies spoke of Venus as having been responsible for “streams of fire” that fell to Earth.[4] After discussing the story from the book of Exodus of the ten plagues, Velikovsky quotes passages from texts in other ancient societies that seem to describe similar misfortunes and also often associate them with Venus. He makes reference to reports from around the world that describe Venus’s movements as seemingly erratic. He notes the growth at that time of an apparent worldwide obsession with tracking the movements of Venus, along with a global apprehension at the appearance of any new comet. It was during

this epoch that comets came to be portents of foreboding and evil.

He discusses ancient astronomic tables from various regions that recorded long lists of the risings and settings of Venus, but whose timings seem significantly out of synch with the known, predictable motions of Venus today. Prior to Velikovsky, these same ancient tables, although they had been set down by cultures that were otherwise believed to be careful observers of astronomy, had been largely disregarded by traditional astronomers, who dismissed them either as being “not trustworthy”[5] or as having been deliberately altered for some unknown ritual purpose. An example of this kind of table is found in the Grolier Codex of the Maya. A text specifically regarding the Venus table pages states:

> The 584 day period between heliacal rises is within one day of the average value of the true synodic period. As will be explained below, even greater accuracy was achieved by applying a correction on successive passes through the table.
>
> But the times allotted to the apparitions of the planet between heliacal rises are much less accurate.
>
> For example, Venus is morning star for an average of 263 days, rather than the 236 days allotted in the table.
>
> In practice, the discrepancy is perhaps not as great as it may seem because of the difficulty in observing the planet when it rises or sets shortly before or after the sun, and because the actual synodic period varies from 581 to 587 days. In addition, the most important station, the time of heliacal rise, will be close to correct, occurring at 584 day intervals.
>
> Nevertheless, the accuracy with which the scribes determined the mean synodic period proves they were competent Venusian observers, and leads to the conclusion that they deliberately altered the length of apparitions for ritualistic purposes.[6]

Following long periods of cosmic rampage, according to Velikovsky, Venus ostensibly settled down into the less disruptive orbit of a proper planet. Velikovsky completes his documentation of the transformation of Venus from a menacing comet into a sedentary planet with quoted passages like this

one, taken from the Valley of Euphrates, which states, “Venus then gives up her position as a great stellar divinity, equal with the sun and moon, and joins the ranks of the other planets.”[7]

As another cross-check on the overall reasonableness of the scenario Velikovsky paints—one in which a comet the size of Venus (roughly the same size and mass as Earth) might make a close approach to Earth—Velikovsky quotes Pierre Simon LaPlace, the author of the five-volume *Mechanique Celeste (Celestial Mechanics),* which serves as a foundation for the modern scientific understanding of celestial mechanics. La Place writes, “The small probability of such an encounter must accumulate during many centuries and will become very great. It is easy to visualize the effect of such a shock on the Earth. . . . The axis and the movement of rotation would be changed. The seas would abandon their ancient positions, in order to precipitate themselves towards the new equator; a great portion of the human race and the animals would be drowned in the universal deluge, or destroyed by the violent shock imparted to the terrestrial globe.”[8]

The mechanism by which Velikovsky proposes that Venus (the comet) might have theoretically come into being also takes its source from the annals of ancient mythology. According to his view, every ancient mythology in the world concerns itself with the birth of Venus.[9] He says that finding the proper mythological counterpart to Venus in any given culture’s mythology is easy: simply inquire about the goddess who is said to have been born into the mythology. As a working example for use in discussions in *Worlds in Collision*, Velikovsky draws parallels to the ancient Greek story of Pallas Athena. In Greek mythology, Pallas Athena (a war goddess who is often associated with Venus) was said to have sprung fully armed from the head of her father, Zeus. Zeus was the leader of the Greek pantheon of gods and was associated with the planet Jupiter. According to myth, the birth of Venus occurred just after Zeus had devoured whole the pregnant mother of Pallas Athena, Metis, who it had been prophesied would give birth to a child even greater than Zeus. Velikovsky interprets this story as reflecting an actual sequence of cosmic events that he believes played out in the night sky in front of the eyes of ancient observers all over the globe. Velikovsky surmises that an astronomic body (Metis) first struck and was apparently absorbed by Jupiter (Zeus) and then caused Venus (Pallas Athena) to be ejected. (By way

of comparison for general scientific plausibility of the proposed scenario, an actual meteor or asteroid was recorded as it struck and was absorbed by Jupiter on June 3, 2010. Although no material is known to have been ejected from Jupiter, the impact created a fireball on the surface of Jupiter that measured as large as the planet Earth.[10] In Velikovsky's timeline—and as is seemingly supported by these widespread myths—the impact of Metis caused a ball of matter to be ejected from Jupiter that took the form of the comet Venus.

Researchers who object to Velikovsky's suggestion that a planet-sized body could be ejected from Jupiter often cite the very high velocity required to escape the gravity of Jupiter and the extreme amount of energy it would take to eject a body the size of Venus from the interior of Jupiter. However, Velikovsky's scenario begins with a planet, meteor, asteroid, or comet (Metis) that may have impacted, passed into or through, or even deflected off of Jupiter. We have no specific information regarding the size, mass, chemical make-up, or momentum of this body, nor do we know precisely where, at what speed, or at what angle it may have hit Jupiter. Nor do we know to what depth inside Jupiter it might have passed if, as reported in myth, it was "swallowed whole." Uncertainties such as these, which cannot be easily evaluated or reconciled, could have bearing on the ultimate reasonableness or unreasonableness of Velikovsky's premise. In any case, for the sake of our continuing discussion, perhaps it is best to simply grant Velikovsky his premise and defer for the moment consideration of the many possible scientific objections that might reasonably be raised against it.

Once free of Jupiter, Venus then began to make its way through the solar system, coaxed by the pull of the gravity of the sun into an elliptical orbit typical of a comet. According to Velikovsky—and based on widespread ancient reports—Venus as a comet then made recurrent passes through the solar system in the same approximate plane of orbit as the planets, eventually wreaking great havoc during a number of specific incidents or cosmic encounters.

Velikovsky places the first such incident involving the planet Earth at or around the time of the immense eruption of the volcano Thera on the island of Santorini. Based on the best evidence of his day, Velikovsky places this event at about 1500 BCE. However, in the years since Velikovsky wrote, the

eruption has been dated by radiometric methods to around 1627 BCE. It is this close approach of the comet Venus to Earth that Velikovsky associates with the ten plagues of the Bible and the story of the Exodus from Egypt. According to Velikovsky, this would also correspond to (and perhaps have largely contributed to) the end of the Middle Kingdom in Egypt, which is now dated by traditional Egyptologists to this same approximate time period, at around 1640 BCE. Thera, which is located in the Mediterranean Sea, is close enough to Egypt for its eruption to have been seen by and to have had important effects on the ancient Egyptians.

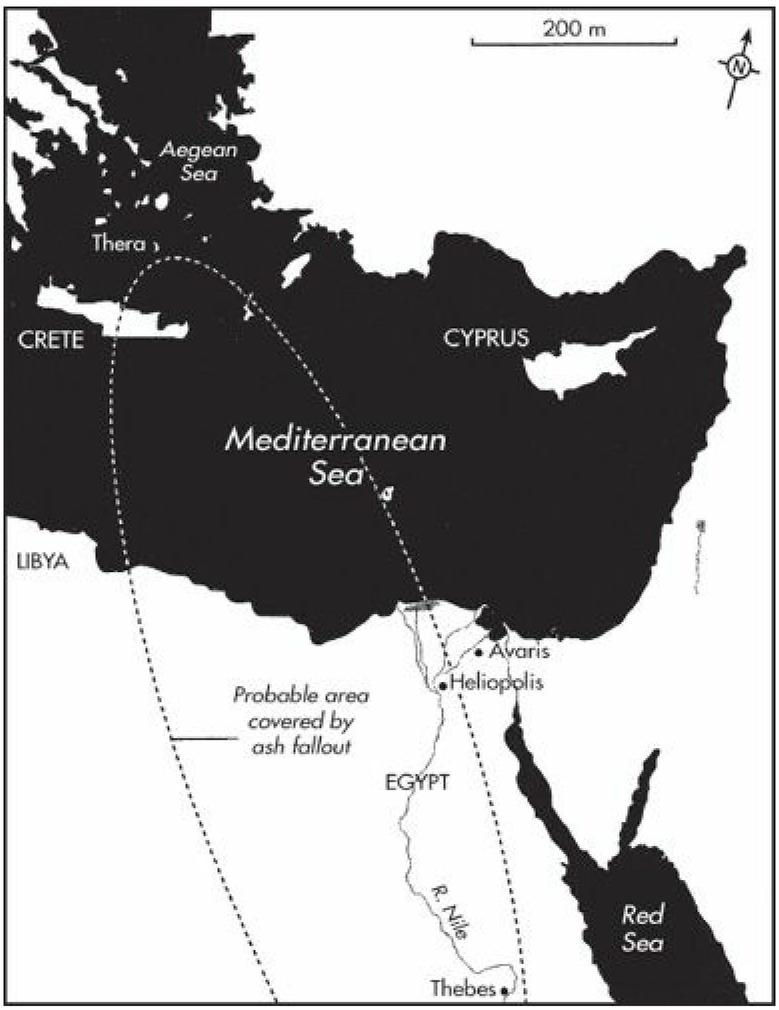

Figure 2.1. Likely area of fallout from eruption of Thera. (From the official graham Phillips Website, www.grahamphillips.net/Books/act_new.htm.)

According to Velikovsky, the “pillar of smoke” by day and “pillar of fire” by night that the Israelites are said to have followed as they left Egypt are references to the way the erupting volcano on Santorini looked (volcanoes are

often characterized by ash and smoke, which during the daylight hours can resemble a gray pillar, and by night a fire).

The eruption of Thera is thought to have been one of the largest known to history, and likely the largest in the last ten thousand years.[11] The timing of the eruption, its location, its size, and the probable area affected by its volcanic fallout could support many of the effects that Velikovsky theoretically assigns to it. Conversely, the close approach of an astronomic body such as a comet might be offered as a rationale to explain the unique intensity of the Thera eruption itself.

Large eruptions that spew out great quantities of ash are known to cause conditions such as darkness, hail of pellet-size volcanic debris, and thunder, as mentioned in the biblical reports in the book of Exodus. The mention of skin boils in the biblical account are consistent with the skin sores and rashes that affected large numbers of residents who lived downwind of the Mount St. Helens eruption in 1980. The Thera eruption is estimated to have been twenty times greater than the eruption of Mount St. Helens.[12] Velikovsky suggests that rusty pigment in the tail of the comet could have been responsible for turning Egypt's rivers red; however, even without demonstrative proof of this speculation, we know that there have been historical reports of storms and eruptions that, under the right circumstances, have turned rivers red. As one example, iron oxide ejected by the Mount St. Helens eruption is known to have caused the death of many fish in rivers, and such iron oxide could well account for waterways seeming to turn red. If, by this or some other mechanism associated with the volcano on Santorini or Velikovsky's comet, the rivers had been widely poisoned, then an increase in vermin such as rats and frogs would be understandable as they left the rivers to seek refuge.

Figure 2.2. Velikovsky's "pillar of smoke"? Photo of Mount St. Helens erupting in 1980. (Image courtesy of the U.S. Geological Survey's Cascades Volcano Observatory)

Somewhat more speculatively, Velikovsky explains the biblical report of the parting of the Red Sea at the time of the Exodus in terms of tidal effects caused by the closely approaching comet that caused the sea to draw back. The sudden collapse of that same water, which was reported to have drowned the pharaoh and his men, who chased the Israelites, was attributed to a sudden electrical discharge between the comet and the planet Earth, similar to those that were observed to occur as the comet Shoemaker-Levy approached Jupiter in 2004.[13] Alternately, it is conceivable that earthquakes associated with the close approach of a comet could have resulted in a tsunami that may have caused water first to draw back, then to surge forward again in a rushing wave that could have drowned the pharaoh and his men.

Once free both of Egypt and of any pursuing Egyptians, the Israelites are said to have wandered in the desert for forty years. According to the Bible, they were able to feed themselves with manna, an edible substance similar to myrrh that is reported to have appeared or precipitated each day with the morning dew. When not collected, legend has it that the manna simply evaporated in the sun as the day progressed. Velikovsky assigns the source of manna to natural components of the atmosphere of the comet that were transferred to and mixed with the atmosphere of the earth as it passed through the comet's tail.

Seven centuries later—around 757 BCE according to Velikovsky's reckoning—another series of close encounters between an astronomic body and the earth began, once again with worldwide reports of the very great

disruption that they caused. Velikovsky points out that these reports fall well into the epoch of recorded history[14] and include explicit statements that are clearly stated in well-preserved documents from Assyria, Egypt, Libya, and Ethiopia, as well as in ancient Hebrew writings. These cataclysms Velikovsky attributes not to the ravages of Venus, but rather to close encounters with the planet Mars.

But Mars seemed to Velikovsky to be an entirely different case than Venus. It had long been cited by worldwide cultures among the list of known planets, and there was no mention in various mythologies of Mars entering the pantheon of gods or family of planets; rather, Mars appeared to have been a known planet since earliest times. Furthermore, prior to the first millennium BCE, Mars did not seem to arouse fear, according to the written annals of human culture. Yet after that time, in regions such as ancient Assyria and Babylonia, Mars is specifically mentioned as having become an erratic agent of destruction and is described in the book of Isaiah as being inexplicably "removed from its place" and having "moved the world exceedingly," causing the "earth to shudder."[15]

As a solution to the problem of what could possibly have caused Mars to move out of its regular orbit and Venus to abruptly settle into one, Velikovsky proposes that there had been a cosmic collision between the two planets. Velikovsky based this conclusion largely on citations drawn from Homer's *Iliad,* which describes two great clashes between Ares (Mars) and Pallas Athena (Venus).

Velikovsky's proposed cataclysm with Mars in 757 BCE—the event he links to various ancient reports of changes in the apparent movements of the sun—is associated with a change in the calendar in the Middle East,[16] which suggests that a change may have occurred at that time, either in the rotation or orbit of Earth. In support of this notion, Velikovsky notes that modern-day retrospective star charts, which are predicated on the presumption that there has been no interruption or change in the rotation or orbit of Earth, calculate that there were no eclipses of the sun visible in the Middle East in the years from 762 BCE through 701 BCE. However, according to Velikovsky, ancient texts dating from that time period clearly include reports of solar eclipses.[17]

According to Velikovsky, each of the recurring approaches of Mars came progressively closer to Earth, again at regular intervals (at periods of fifteen

years between each, according to some sources.) These facts allowed the biblical prophets to predict the timing and relative severity of each upcoming disaster. The closest of these encounters were characterized by a great shaking of the earth that, unlike familiar earthquakes (which typically strike with a sudden immediacy) arrived with sufficient warning for the residents to flee their cities or homes and take refuge in caves and in the earth prior to an incident.[18] The last of these encounters, which Velikovsky dates to the seventh century BCE, was responsible for restoring Mars to the more circularized orbit that we know it to have today. Velikovsky suggests that the fifteen-year cycle at which Earth and Mars now make their nearest orbital approach to one another may be a remnant resonance of these close contacts in ancient times.

3

REACTION AND CONTROVERSY

As we have explained by way of introduction, it was within a context of anger and apprehension among the scientific community that the controversy over Velikovsky's book came to provoke one of the most remarkable incidents in modern academia, one in which the leaders of the astronomic establishment worked together to actively suppress (rather than quietly and factually evaluate) an emerging, inconvenient, controversial theory. As a prelude to this incident, in 1945 Velikovsky self-published two small *Scripta Academica* pamphlets that offered an overview of his theories in 1945. These were titled *Theses for the Reconstruction of Ancient History* and *Cosmos Without Gravitation*. Seeking an informed review of his concept, in 1947 Velikovsky had mailed a draft of this early work to Dr. Harlow Shapley, then director of the Harvard Observatory. Shapley, however, did not give the piece a very warm reception.

Three years later—in January of 1950—a widely read condensation of the argument of *Worlds in Collision* was published by *Harper's* magazine, only weeks before the April 3 publishing date on which the book itself would appear. This condensation helped to set the stage for a rising sense of outrage among astronomers. Almost immediately thereafter—on January 18 and 25 (1950)—Shapely wrote his first letters to Macmillan and Company, loudly protesting their plans to publish Velikovsky's book. As a consequence of Shapley's letters, Macmillan agreed to appoint a panel of "censors," and eventually enlisted four scientifically qualified readers to read a prepublication galley of the book and offer recommendations to Macmillan as to whether it should proceed with its publication. In the end, all four censors voted in favor of publication, although one did so with reservations.[1]

Around the the same time, Gordon Atwater, who was the director of the Hayden Planetarium, felt that Velikovsky's theories seemed plausible and made preparations to produce a show for the planetarium that would be based on Velikovsky's *Worlds in Collision* scenario. Atwater also wrote a favorable

review of the book for the magazine *This Week*, a supplement to the *Herald Tribune.* On March 28, 1950, Atwater was dismissed from his position at the planetarium, five days before his review appeared in *This Week.*[2]

Later—after the book itself had been released by Macmillan and Company but prior to actually reading the book himself—Dr. Harlow Shapley (then director of the Harvard Observatory)—wrote a letter to the Macmillan Company declaring the book to be nothing but "nonsense and rubbish." Shapley also encouraged his colleague, Harvard professor Cecilia Payne-Gaposchkin, to write a detailed response to Velikovsky's theory, again before she had actually read the book. Fred Whipple—another prominent astronomer of the day and successor to Shapely at the Harvard Observatory—announced that he would break his relationship with the publisher over the book and withdraw from a proposed project to revise his own book *Earth, Moon and the Planets*. Dean McLaughlin, Professor of Astronomy at the University of Michigan, wrote Macmillan on May 20, 1950 to protest the "promulgation of lies" in Velikovsky's book, also confessing later in the letter to not having actually read the book. Meanwhile, the book had already shown itself to be a runaway bestseller and had quickly moved to the top of the bestseller lists.

Meanwhile, the controversy had captured the attention of the scientific community at large. On June 25, 1950, four Yale professors joined together in an article written for the *American Journal of Science* to disprove *Worlds in Collision.* Around the same time, efforts were also made within the academic world to sabotage Macmillan's inventive solution to the problem and to discourage Doubleday from picking up the book. On June 30, 1950, David Grahame, a professor of chemistry at Amherst College, wrote to Doubleday, saying, "Scientists are now engaged in an active boycott of the Macmillan books, and though scientists are not important buyers of your books, their opinion should be heeded by any publisher who intends to publish a book which purports to be science. I trust that you can be dissuaded."[3]

In September 1950 the *Harvard Crimson* published another article, titled "Shapley Brands *Worlds in Collision* a Hoax: Scientists' Attacks, Pressure Make Macmillan Call Off Publication." This article described the incident with Velikovsky as the "biggest uproar in scientific circles since Newton and

Darwin." Among other things, the authors asked, "If there is nothing to Dr. Velikovsky's thesis, why were so many people trying to discredit and silence him?"[4]

Ongoing interest in Velikovsky and his controversial theories, which still persists more than half a century later, is fueled perhaps by a long history of denial and continuing discovery. The pattern of exchange has typically involved the flat dismissal by some member of the scientific community of some controversial aspect of Velikovsky's view, followed by the eventual discovery of some new fact that might be interpreted to specifically uphold it. In each case, the reaction of the scientific community has been typified by a kind of fraternal vow of silence among astronomers, often characterized by unapologetic omission of any mention of Velikovsky or his theories. Often new discoveries that might be seen to support Velikovsky are met with the impromptu introduction of some new counter-theory that may have never before been considered or proposed and whose main effect is often to explain away the unanticipated finding in non-Velikovskian terms.

Thus when Velikovsky surmised that Venus—as a recently formed astronomic body—must still be very hot (a prediction offered by Velikovsky as a decisive test for his theory), his view, which went against the conventional wisdom of the day, was at first flatly dismissed. In 1963, when the Mariner 2 space probe actually verified the near-molten temperature of the surface of Venus, scientists such as Carl Sagan stepped up to propose the theory of a runaway greenhouse effect on Venus—along with the theoretic chemistry and physics to support it—that could explain away the result without concluding that Venus must be younger than billions of years old. In the eyes of astronomers, the mere suggestion of an alternate theory that they could publicly anoint as "likely" somehow absolved them of the responsibility to reconcile the new finding with Velikovsky's prediction.

Likewise, because in Velikovsky's view Venus represented a new planet, his outlook required that it be found to have the pristine surface of a young astronomic body. One typical test astronomers use to estimate the likely age of a body in our solar system is to count the number of impact craters. The more craters that are found to exist, the older the body is deemed to be. When, in fact, the surface of Venus was eventually shown to have far fewer impact craters than would be expected for an ancient body, astronomers

quickly proposed and then collectively endorsed—this time with no real supporting scientific evidence at all, other than preconceived expectation—the solution that “unknown geological forces” must have somehow recently refreshed or resurfaced Venus in its entirety. Again, this declaration was seen to somehow relieve the scientific community of an obligation to reconcile the unexpected finding with Velikovsky’s predictive statements.

Isaac Asimov, a well-known author of science fiction and popularizer of science, addressed himself to the question of why there had been such an uproar over the theories of Immanuel Velikovsky and why that uproar had seemed to persist for so many years. He wrote in his foreword to *Scientists Confront Velikovsky:*

> Of all the exoheretics, Velikovsky has come closest to discomfiting the science he has attacked, and has most successfully forced science to take him seriously. Why is that? Well—

Velikovsky has been a psychiatrist, so that he has training in a scientific specialty of sorts and is not an utter exoheretic. What’s more, he has the faculty of sounding as though he knows what he is talking about when he invades the precincts of astronomy. He doesn’t make very many elementary mistakes, and he is able to use the language of science sufficiently well to impress a layman.

He is an interesting writer. It’s fun to read his books. I have read every book he has published and hope to read any he writes in the future. Although he doesn’t lure me into accepting his views, I can well see where those less knowledgeable in the fields Velikovsky deals with would succumb.

Velikovsky’s views in *Worlds in Collision* are designed to demonstrate that the Bible has a great deal of literal truth in it, that the miraculous events described in the Old Testament really happened as described. To be sure, Velikovsky abandons the hypothesis that divine intervention caused the miracles and substitutes a far less satisfactory hypothesis involving planetary Ping-Pong, but that scarcely alters the fact that in our theistic society any claimed finding that tends to demonstrate the truth of the Bible is highly likely to meet with general favor.

These three points are enough in themselves to explain Velikovsky’s

popularity.[5]

After more than sixty years, many of the central questions of the Velikovsky controversy continue to seek resolution. The sheer longevity of the debate has tended to create a kind of *reasonable doubt* that may work in Velikovsky's favor. One is reminded of a Magic 8 Ball, a toy used by children to make ostensible predictions, but whose outcomes—as any adult can clearly see—are solely based on random chance, not some unknown magical prophetic power. Yet somehow, when it comes to scientific questions that pertain to Velikovsky, time and again answers seem to keep coming up on his side of the argument. Altogether, the progression of events has served to leave much of the nonscientific public with a lingering doubt—one that is partly fortified by Velikovsky's popular underdog status. In the end, the casual observer might well wonder whether many of Velikovsky's seemingly outrageous views about the history of Venus may yet somehow ultimately prove themselves out.

4

EARLY PREDICTIVE TESTS OF THE THEORY

Immanuel Velikovsky used inference, logic, and other tools of a comparative mythologist to derive a likely sequence of events in the cosmic drama that he outlined in *Worlds in Collision.* Consistent with that approach, if his scenario were true, he realized that there would be certain predictive conclusions that could be drawn about the various astronomic bodies purported to have participated in his theoretic drama. Velikovsky considered the likely consequences of his theory and publicly set forth several of what he called “advance claims” by which the correctness of his theory could be judged. Some of these predictive statements fell within the ability of scientists in the 1950s and 1960s to definitively test, others had been addressed by the end of the twentieth century, while yet still others remain a matter of ongoing contention between Velikovsky’s supporters and detractors.

That many of these claims take the form of logical conclusions that can be derived based on the proposed sequence of cosmic events Velikovsky defines in his *Worlds in Collision* thesis is hard to dispute. Likewise, many of the claims reflect views that ran diametrically against conventional scientific wisdom in 1950, so their odds of ultimately being shown to be true could only be called very slim at the time they were put forth. Still, many scientists who dispute Velikovsky’s thesis often tend to view any apparently successful claim of Velikovsky’s as a matter of pure luck or simple coincidence. In other cases they may allow that Velikovsky’s prediction was correct but ultimately discount it on the grounds that Velikovsky made the prediction “for the wrong reasons” or because he failed to quantify his anticipated result in some way.

From the viewpoint of a traditional scientist in 1950, Velikovsky’s proposed history for Venus raised a host of immediate questions that, because they so wildly contradicted the conventional view of the day, begged for direct answers. Since the publication of *Worlds in Collision* preceded our ability to launch space probes capable of gathering much of the data upon

which the answers to these questions turned, many could not be fully answered in 1950. In truth, despite the outward intransigence of the scientific community, astronomers at that time only held the most tenuous notions of what they might ultimately find once future probes succeeded in reaching Venus. Patrick Moore, a well-respected English astronomer and media commentator, stated in a 1995 interview on the PBS-TV series *NOVA*, “I have been observing Venus ever since 1934, when I was a boy of eleven, and in that time I’ve seen the whole gamut of emotions. Theories have come, theories have gone. [Our view of] Venus has changed: either it was a watery world, or it was a carboniferous world, or a desert. I’ve seen it all. . . . I remember. . . giving a talk, I think, in London University in the 1950’s and I said then that, quite possibly, Venus, as a potential colony, might be more promising than Mars.”[1]

From Moore’s perspective, it might be fair to say that the facts as we understand them today regarding Venus and its demonstrated attributes lie as much in contradiction of the prevailing scientific views of Venus of 1950 as any of Velikovsky’s claims, many of which were flatly characterized at the time as “wild.” Moreover, it may be fair to say that a growing number of the points made by Velikovsky that were so heatedly disputed in 1950 have since shown themselves to be true. Because the events described in *Worlds in Collision* and their potential implications ran so completely counter to the worldview of most scientists at the time, the widespread presumption among many traditional scientists was that any predictions that might be made based on Velikovsky’s theories would never stand up to critical examination. However, within a relatively short time after publication, several new astronomic discoveries seemed to support Velikovsky’s view, so that presumption began to seem less well-founded.

Among the predictive claims made by Velikovsky for his scenario, some were given in *Worlds in Collision* and others in speeches or articles written after the book was published. As we have suggested, some of these were offered up by Velikovsky as definitive tests of his theory and so provided a basis upon which his seemingly outrageous claims could be challenged. To begin with, key aspects of Velikovsky’s scenario of catastrophe rested on a presumption that the bodies of the solar system must be electrically and magnetically charged and that electromagnetic effects must play a significant

role in their interactions—a view that sharply contradicted mainstream scientific beliefs in 1950. In reaction to these views, in a 1952 book titled *In Fads and Fallacies in The Name of Science,* author Martin Gardner accused Velikovsky of having invented "electromagnetic forces capable of doing precisely what he wants them to do. There is no scientific evidence whatever for the powers of these forces. But so convinced is the hermit scientist that everyone is prejudiced except himself, that he can with a straight face belabor the 'orthodox' for refusing to recognize these imaginary energies!"[2]

Perhaps the first public vindication of one of Velikovsky's unconventional advance claims came in response to this very issue. On October 14, 1953, at the behest of Princeton geology professor Harry Hammond Hess, Velikovsky addressed the Forum of the Graduate College of Princeton University in a lecture titled "*Worlds in Collision* in the Light of Recent Finds in Archaeology, Geology and Astronomy: Refuted or Verified?" and ended the talk with this statement: "The planet Jupiter is cold, yet its gases are in motion. It appears probable to me that it sends out radio noises as do the sun and the stars. I suggest that this be investigated."[3]

Discussion of the possible importance of electromagnetic effects in the solar system dominated a longtime correspondence between Immanuel Velikovsky and Albert Einstein, which began in 1946 and continued until Einstein's untimely death in 1955. The question of what role electromagnetism might play in the interaction of astronomic bodies had potential bearing on Einstein's search for a unified field theory. Nonetheless, Einstein resisted Velikovsky's ideas, even when directly approached by Velikovsky in June 1954 to use his influence to have Jupiter surveyed for radio emissions, a request that Einstein effectively deflected. But, as good fortune (or good insight) would have it for Velikovsky, soon after, on April 5, 1955, two astronomers from the Carnegie Institute (B. F. Burke and K. L. Franklin), who had no apparent knowledge of Velikovsky's suppositions regarding Jupiter, announced the chance detection of radio signals from Jupiter. With this news, a somewhat embarrassed Einstein reversed his opinion, dropped his resistance to Velikovsky's proposal, and instructed his secretary to authorize—in Einstein's name—any test that Velikovsky might wish to have conducted. Thirteen days later, on April 18, 1955, Einstein was found dead—the victim of a ruptured aortic aneurysm. At the time of his

death, it was reported that the one book found open on Einstein’s desk was Velikovsky’s *Worlds in Collision.*

Also, in 1952, Donald Menzel of Harvard University spoke up to dispute Velikovsky’s claims regarding electromagnetism and the sun, purporting that the sun was incapable of holding a charge sufficient to satisfy Velikovsky’s model. Eight years later, in 1960, Professor V. A. Bailey of the University of Sydney, Australia, demonstrated—again without apparent knowledge of Velikovsky’s proposal—that the sun carries a net charge precisely sufficient to meet Velikovsky’s unorthodox claims.[4]

Closely related to Velikovsky’s suggestion that electromagnetism must play a significant role in dynamics within the solar system—also proposed by Velikovsky in the same speech to students at Princeton in October 1953—was the suggestion that Earth must exert a magnetic influence that extends out into space as far as the moon. Velikovsky further outlined this idea in a 1956 memorandum to the American Committee for the International Geophysical Year that was submitted to the committee by Hess, the receipt of which was acknowledged by the committee. A few years later, in 1958, James Van Allen announced and was ultimately credited with the discovery of the magnetosphere.

Another early prediction of Velikovsky’s in regard to Venus—presented in the final chapter of *Worlds in Collision* and offered as a definitive test of his theory—was that if Venus were a relatively new astronomic body that had “blazed brightly” and “rivaled the sun in brightness in the daytime sky,” according to some ancient sources, then it must be found to still be quite hot, nearly molten, according to Velikovsky. At the time of Velikovsky’s statement, the clouded surface of Venus was “known” to be -25 degrees Celsius on both the day and night sides, so Velikovsky’s view could hardly have been called a safe bet based on then-conventional wisdom. In 1954, N. A. Kozyrev observed an emission spectrum from the night side of Venus but ascribed it to discharges in the upper layers of its atmosphere. He calculated that the temperature of the surface of Venus must be 30 degrees Celsius; somewhat higher values were found earlier by Arthur Adel and Gerhard Herzberg.[5]

As late as 1959, V. A. Firsoff arrived at a figure of 17.5 degrees Celsius for the mean surface temperature of Venus, only a little above the mean annual

temperature of Earth (14.2 degrees Celsius).[6] Nonetheless—in support of Velikovsky and in contradiction to the prevailing astronomic view—late in 1962 and early in 1963, the Mariner 2 probe showed the actual surface temperature of Venus to be about 460 degrees Celsius (800 degrees Fahrenheit)—hot enough to melt lead.

As a consequence of these early points of seeming vindication for Velikovsky, at around this same time, one of the few public acts of professional recognition for Velikovsky's correct predictions occurred. Two leading academics (Valentine Bargmann of the Princeton University Department of Physics and Lloyd Motz of the Columbia University Department of Astronomy) wrote a letter to *Science* magazine to acknowledge Velikovsky's priority on these points and to urge that his other conclusions be objectively reconsidered—this in spite of their own stated misgivings about Velikovsky's broader theories.

As another consequence of Venus's proposed erratic history as a rogue astronomic body and its theoretic interactions with Earth and Mars, Velikovsky suggested that Venus would be found to have an anomalous rotation when compared with the other planets in the system. In late 1962, ground-based observations from the Goldstone tracking station in California and the U.S. Naval Research Laboratory in Washington showed that Venus—unlike other planets—had a slow, retrograde rotation. Moreover, in April 1966 it was shown that Venus's rate of rotation exhibited a resonance with the rotation of Earth, such that every time Venus passes between the sun and Earth (at a point called the inferior conjunction), Venus always showed the same side to Earth, much as the moon continually presents its same side to Earth during its monthly orbit. Of course, as with almost any scientific observation, there is a very small chance that this type of apparent resonance could simply be a matter of grand coincidence. Alternately, such resonance might be explained by tidal forces of gravity if it could shown that the orbits of Venus and Earth were close enough to one another to be significantly affected by gravitational tidal forces. On the other hand, this type of classic resonance is also known to result from the close approach of two astronomic bodies, similar to the approaches proposed by Immanuel Velikovsky to have occurred between Venus and Earth.

Other advance claims of Velikovsky's seem to have been beyond the ability

of twentieth-century science to either confirm or deny and so could not be subject to immediate resolution. Some of these involved questions whose answers turn on evidence that would not be gathered until future probes were sent into space during the first decade of the new century. Both Velikovsky's defenders and detractors would have to satisfy themselves to be patient until future evidence could be brought to bear on these subjects.

Despite these seeming successes, most scientists remained wary of offering public support to Velikovsky. Even one of Velikovsky's most steadfast friends, Harry Hammond Hess, then chairman of the Space Board of the National Academy of Science, wrote the following to Velikovsky in 1963.

> We are philosophically miles apart because basically we do not accept each other's form of reasoning—logic. I am of course quite convinced of your sincerity and I also admire the vast fund of information which you have painstakingly acquired over the years.
>
> I am not about to be converted to your form of reasoning though it certainly has had successes. You have after all predicted that Jupiter would be a source of radio noise, that Venus would have a high surface temperature, that the sun and bodies of the solar system would have large electrical charges and several other such predictions. Some of these predictions were said to be impossible when you made them. All of them were predicted long before proof that they were correct came to hand. Conversely I do not know of any specific prediction you made that has since been proven to be false. I suspect the merit lies in that you have a good basic background in the natural sciences and you are quite uninhibited by the prejudices and probability taboos which confine the thinking of most of us.
>
> Whether you are right or wrong I believe you deserve a fair hearing.[7]

5

LATER DEVELOPMENTS IN THE CONTROVERSY

Interest in Velikovsky and his book *Worlds in Collision* resurfaced in July 1969 with the first manned moon landing. In response to an invitation by the *New York Times,* Velikovsky wrote a summary of his expectations of what would be found to be true about the moon based on the *Apollo* missions. He listed nine specific claims, including his belief that remnant magnetism would be found on the moon, that the surface of the moon would exhibit a steep thermal gradient, that radioactive "hot spots" would be found, and that the moon would be shown to suffer from frequent moonquakes. All of these predictions eventually proved to be true.

In 1972, the Society of Harvard Engineers and Scientists invited Velikovsky to speak to the Harvard student body, effectively returning him to the scene of Shapley's infamous textbook boycott. After his speech he received a standing ovation. He was quoted as having said, "I survived, you see. I have been waiting for this evening for twenty-two years. I came here to find the young, the spirited, the men who have a fascination for discovery."[1] Around the same time, Velikovsky's cause began to be championed by a small intellectual journal in Portland, Oregon, called *Pensée.* The journal published a series of issues that were devoted to Velikovsky and that provided a public forum for articles written by Velikovsky himself. The journal became the catalyst for a surge of renewed interest in the questions posed by *Worlds in Collision,* at first on college campuses, and then within the intellectual community at large.

Suddenly Velikovsky, who had been effectively relegated to the status of persona non grata for more than two decades, began to receive invitations to speak at various colleges and universities. He and his work became the subject of television documentaries produced by BBC and by the Canadian Broadcasting Corporation. Velikovsky was invited to speak at an

international symposium in Toronto, Canada, and presented a lecture at the Ames Research Center, part of the National Aeronautics and Space Administration (NASA).

In 1974, the American Association for the Advancement of Science (AAAS) proposed a gathering in San Francisco that was promoted as a direct debate between Velikovsky and one of his most vocal critics, the well-known popularizer of science, astronomer Carl Sagan. Sagan had been a former researcher and lecturer at Harvard University and was the associate director of the Center for Radio Physics and Space Research at Cornell University. This event, which has since been the focus of several books on the Velikovsky controversy, is largely remembered as a final public refutation of Velikovsky and his theories. Since then, most traditional astronomers have considered his theories and the uncomfortable questions they raised to effectively be closed issues.

In November 1974, Velikovsky attended a symposium called “Velikovsky and the Politics of Science,” conducted at a meeting of the Philosophy of Science Association at the University of Notre Dame. Velikovsky engaged in a dialogue with Washington University Professor Michael Friedlander, who confronted him with examples of what Friedlander characterized as Velikovsky’s “substandard scholarship.” These included a brief passage from R. A. Lyttleton that had apparently been misquoted by Velikovsky in *Worlds in Collision.* Other critiques of Velikovsky’s scholarship have been published, some of which also criticize his use of quoted material and others that question his interpretation of various ancient texts and myths. One frequent complaint of casual students of mythology in regard to Velikovsky arises out of an apparent confusion between very early references in ancient Greek mythology to Athena—a likely surrogate for the Egyptian mother goddess Neith—and variant Greek myths that define Pallas Athena as the daughter of Zeus and who was said to have sprung from the head of Zeus.

Among the scientific arguments consistently raised against the scenario presented in *Worlds in Collision* is the view that the various changes in motion required of Venus and Mars seem to violate basic principles of celestial mechanics. Astronomers argue that had Venus once been a comet as Velikovsky claims, it would be unreasonable to think that its orbit could have circularized in only a few thousand years. It is also argued that, given the

types of recent upheaval proposed by Velikovsky, we should see evidence of recent disturbance in the orbits of Mars and the moon. Some astronomers argue that the close encounter of two astronomic bodies tends to greatly incline the orbit of one of the bodies, yet none of the planetary orbits involved seem to have become inclined—this notwithstanding the fact that Venus exhibits the most inclined orbit of any of the planets. (In truth, close encounters between astronomic bodies *of significantly different sizes* tend to incline the orbit of the smaller body. In Velikovsky's scenario, Venus and Earth were very nearly the same size, so an encounter may well not have resulted in any dramatic inclination of orbit, while Venus and Mars are said to have actually impacted one another, not simply made a close approach.)

Some geologists have argued that, had Venus wreaked chaos on Earth around 1500 BCE, as Velikovsky claims, we should see evidence of the event in global ice cores, purporting that no such evidence exists. C. Leroy Ellenberger writes, "The Terminal Cretaceous Event 65 million years ago, whatever it was, left unambiguous worldwide signatures of iridium and soot. The catastrophes Velikovsky conjectured within the past 3,500 years left no similar signatures according to Greenland ice cores, bristlecone pine rings, Swedish clay varves, and ocean sediments. All provide accurately datable sequences covering the relevant period and preserve no signs of having experienced a Velikovskian catastrophe."[2]

However, contrary to Ellenberger's statement, there can be little doubt of extensive worldwide evidence (since the evidence in fact exists) of a major catastrophe at the very time Velikovsky claims, which is traditionally attributed to the many volcanic eruptions of that period, without regard to the possibility that those eruptions could have been caused by a theoretic catalyzing agent. The unanswered question is whether a cosmic event such as Velikovsky proposes could have precipitated those eruptions. In an *Environmental Geology* article, P. E. LaMoreaux writes:

> The eruptions of Thera (Santorini) between 1628 and 1450 BC constituted a natural catastrophe unparalleled in all of history. . . . There had to be massive loss of life from ejecta gases, volcanic ash, bombs, and flows. . . . At distant points in Asia Minor and Africa, there was darkness from ash fallout, lightning, and destructive earthquakes. Earthquake

> waves emanating from the epicenter near the ancient volcano were felt as far away as the Norwegian countries. . . . Volcanic ash spread upward as a pillar of fire and clouds into the atmosphere and blocked out the sun for many days. The ash reached the stratosphere and moved around the world where the associated gases and fine particulate matter impacted the atmosphere, soils, and waters. . . . Climatic changes were the aftermath of the eruption and the atmospheric plume was to eventually affect the bristlecone pine of California; the bog oaks of Ireland, England, and Germany, and the grain crops of China.[3]

Typically, when a large meteor strikes the earth, traces of iridium are found in the layer of ash that is left behind in the geological record. Some Velikovskian critics cite the lack of iridium in the Thera ash as a disproof of Velikovsky's viewpoint. However, again, because Velikovsky postulates only a close approach of Venus, not an actual impact, there would be no apparent cause for iridium to have intermingled with that ash.

Extensive arguments have been made against the idea that a close approach of Venus or Mars could have changed either the rotation of Earth or the tilt of its axis, as Velikovsky proposes. However, a 2002 study of possible causes of the ice ages cites arguments in favor of just such gravitationally induced changes in the tilt of the axis as a way to explain both the types of ice and patterns of glaciation that are observed to accrue during ice ages. The author of the study presents graphs of the measurable gravitational perturbations that are known to occur, even today and from a great distance, whenever Venus and Earth come into conjunction with one another. These cause the orbit of Earth to slow somewhat as the planets approach each other. He argues that the precessional effect of this type of interaction might be enough to induce long-term changes in the tilt of the axis of Earth. Clearly, these same effects acting from a much closer distance might theoretically have done the same, and to a greater extent.[4]

Other arguments have been raised against various atmospheric or chemical interactions Velikovsky proposes, and each has been met with counterarguments, published by researchers who dispute them. The many technical intricacies of these arguments have been the subjects of previous books about Velikovsky, so they may not bear repeating here. In many cases,

it seems that Velikovsky's presentations of these proposed interactions are overly vague and not set forth with enough precision to ultimately verify or refute them. However, my view is that even if we were to conclude that these claims by Velikovsky are largely unprovable, none has significant bearing on the key events of Velikovsky's scenario, and so they should properly be relegated to the role of secondary questions.

One approach that has often been taken by critics of Velikovsky when lobbying against his theories has been to seize on some isolated aspect of the theory, such as the great unlikelihood of a body the size of Venus ever being ejected from Jupiter, and then calculating an overwhelming numerical statistic to be offered up against the plausibility of Velikovsky's scenario. Few of Velikovsky's opponents have thought, however, to address the larger question of the relative feasibility or unfeasibility of Velikovsky's overall scenario. None seems to pose the pertinent question: based on the evidence, could events such as Velikovsky proposes have occurred?

More than sixty years have passed since the publication of *Worlds in Collision.* During this time much good work has been done by scholars in the fields of ancient studies and astronomy, ancient texts have been uncovered and translated, and researchers have had the opportunity to reevaluate some difficult and poorly understood works, such as the Venus tables of various ancient cultures. These decades have seen the advent of the space age, along with a growing number of successful scientific missions to the moon and to Mars, Jupiter, and Venus. We have witnessed the comet Shoemaker-Levy as it actually impacted the face of Jupiter, and we've had a chance to test soil samples on Mars and to examine moon rocks brought back from the lunar surface. Much new good data has been gathered and compiled to improve our understanding of the true nature of comets and the actual chemical composition of the atmospheres of various planets. We've improved our understanding of how the sun functions and how electromagnetic effects combine with gravity to influence astronomic bodies. Given all of this, we could say that right now—here at the beginning of the second decade of the new century—seems like a good moment to stop and reconsider Velikovsky's thesis and to revisit many of his prognostications in the light of an additional half-century of scientific evidence. Surely this new body of knowledge we have acquired will enable us to shed new informative light on

either the apparent truthfulness or ultimate folly of Velikovsky's many controversial claims.

Worlds in Collision raised a broad, tangled set of complex and often interrelated questions that can be difficult to discuss without a clear organizational plan. These include a number of pivotal issues (such as whether a 365-day year was observed by cultures in ancient times or whether some documented fact can be used to ascertain an unequivocal age for Venus), any one of whose unfavorable resolution (from Velikovsky's perspective) would cause the whole of Velikovsky's theory to come crashing down to the ground. Yet somehow, each of these issues still manages to elude a definitive answer—a somewhat surprising fact, given the large number of researchers who have ardently opposed Velikovsky's views and the very great length of time they have had in which to gather the proof that would show him to be definitively wrong.

Although it seems clear that some aspects of Velikovsky's rendition of events could not have occurred precisely as he describes them or perhaps even be attributed to the specific causes he tentatively assigns to them, an ongoing number of recent scientific discoveries continue to seemingly affirm discrete points in his thesis. Each new scientific revelation adds to a growing impression that if in fact Velikovsky's views are flatly wrong, he surely must be considered one of the very luckiest researchers to ever have lived. Perhaps our most productive approach when attempting this review of Velikovsky's scenario would be to simply revisit each of its most controversial aspects, one chapter at a time, in the chronological sequence in which they ostensibly occurred. We might then ask ourselves what new evidence has emerged that could be interpreted either to support or contradict the many controversial claims made by Velikovsky so many decades ago in 1950.

6

VENUS IN ANCIENT TIMES

Because Venus is central to all aspects of Velikovsky's thesis in *Worlds in Collision,* the task of reconciling Velikovsky's views and predictive statements about Venus with recent findings might be seen as a somewhat more difficult task than for the other cosmic bodies he mentions. If we want to be true to the effort, we really must consider new evidence that has been uncovered from ancient sources since Velikovsky published in 1950 (to be discussed in this chapter), evidence that might uphold or contradict Velikovsky's claim that Venus began its life as a comet (offered in intermediate chapters of this book), and new data that could pertain to Velikovsky's predictions about Venus the planet, gathered by various modern space probes (to be discussed in the later chapters of this book.) In this current chapter, what we would hope to show based on recently discovered ancient sources is whether it appears that Velikovsky "creatively" misinterpreted, mistranslated, or otherwise mistook the ancient texts he studied as a way to wishfully fulfill his thesis, or whether more recent, independent translations of texts will appear to support the scenario he set down.

In *Worlds in Collision,* Immanuel Velikovsky correlated statements from many different ancient cultures, quoting references to Venus from around 1500 BCE that seemed to describe it as a brilliant horned comet, shining brightly enough to induce ancient astronomers to classify it alongside the sun and the moon. Interestingly, ancient astronomic texts that have surfaced since Velikovsky wrote in 1950 do seem to support his view. For example, in China, a Shang dynasty (1766 BCE–1050 BCE) oracle bone (an ancient carved animal bone used to record astronomic events and the earliest known form of writing in China) tells of the appearance in 1054 CE of a "guest star" (a term most likely used to describe a nova or supernova) and compares its appearance to Venus, stating that "during daylight it appeared like Venus, with horned rays radiating in all directions," both a description and stated

time of visibility that cannot be reasonably applied to Venus today.[1] A Korean astronomic reference from 1066 CE describes the appearance of a “broom star” (comet) whose appearance and length was said to be “like Venus.”[2] Another Korean observation from 1222 CE mentions in regard to Halley’s Comet that “it was seen in daylight. Venus was also seen to cross the sky during daylight.”[3] Likewise, there are textual references to Venus from ancient Japan that can be seen to similarly support Velikovsky’s portrait of Venus as a comet turned planet. One study of these references states:

> Being an inferior planet, Venus can never be more than 48 degrees from the Sun, and it is brightest, magnitude -4.8, when its elongation is 40 degrees. Its brightness is one thousandth that of a full moon, but it is 100 times brighter than first magnitude fixed stars like Spica and Regulus, and then Venus sometimes can be seen in the daytime. *On’myoji* called the phenomenon *Taihaku-chu-ken* (Venus-daytime-visible) and considered it as an omen of coup d’etat. It is because the ancient Chinese and Japanese saw the planet “competing in brightness” with the Sun when it was seen in the daytime, and that they considered the Sun as the lord and the inferior planets as chamberlains, and besides Venus was the significator of the general.[4]

While under appropriate circumstances some careful modern observers still report an ability to see Venus during the day, or at least well after sunrise, none today could reasonably describe Venus or any other planet as in any way “competing in brightness” with the sun.

If, as Velikovsky suggests, Venus did make its first appearance as a comet, historical references suggest that its transformation into a well-behaved planet may have taken as long as three millennia. As recently as October 29, 1604, Korean astronomic texts record the sighting of a new supernova, described as being “as big as Venus with its outstanding rays.”[5] Additional evidence in support of Velikovsky’s claims that Venus appeared first as a comet can be drawn from ancient Meso-American references. Susan Milbrath states in her book *Star Gods of the Maya*, “The Aztec Codex Telleriano-Remensis represents Venus as a smoking star in 1533 CE, linking Venus to imagery of comets. . . . A Maya text in the Songs of Dzitbalche seems to identify Venus as a smoking star.”[6]

In *Worlds in Collision*, Velikovsky cites as evidence in support of his theory the many inexplicable differences between values (counts of the number of days between the risings and settings of Venus) recorded in Babylonian astronomic tables in the mid-seventh century BCE and those compiled by modern observers. One might wonder, given the sixty-some intervening years since Velikovsky wrote, whether an academic consensus might have emerged against that view. In a 2000 article titled "On the Astronomical Records and Babylonian Chronology," V. G. Gurzadyan of the Astronomy Centre of the University of Sussex provides a rationale to explain these apparent differences. He bases his explanation of the apparent inaccuracy of the tablets on what he calls "background noise," a combination of errors in transcription, theoretic observational difficulties caused by weather, and ostensible arbitrary changes in the Babylonian calendar, which were imposed whenever practicality may have demanded it. But even in light of those mitigating circumstances, Gurzadyan still seems to fall short of actually endorsing the comparability of the tables to modern sightings. He writes:

> The tablet recorded the rise times of Venus and its first and last visibility on the horizon before or after sunrise and sunset (the heliacal risings of Venus) in the form of lunar dates. These observations are recorded for a period of 21 years. . . . It is a well-known fact that the Venus Tablet dataset contains numerous errors. . . . Doubt can be cast upon the records of the Venus Tablet concerning issues ranging from their apparent regularity to local conditions influencing visibility. This means that even if the data preserved were completely uncorrupted, the interpretation of the Venus Tablet would still be far from straightforward.[7]

However, the idea that variances from modern observations of Venus can be explained based on recording errors in the Babylonian tablets is flatly disputed by Livio C. Stecchini, a professor of quantitative science at the Massachusetts Institute of Technology, in *The Velikovsky Affair*, which was published in 1967. He writes, "In truth, the possibility of error is to be excluded. There were two originals of the Venus tables, each different in the manner of presenting the data, but both so organized that all the entries cross-check each other. There are minor errors of transcription in the several

copies, but such that they can easily be eliminated by collating one copy with another."[8]

Similar difficulties appear to exist, as Velikovsky suggested, with the Venus tables presented in the Dresden Codex of the Maya, which date from the mid-1500s. In a 2002 article, one analyst writes, "The 584 day period between heliacal rises is within one day of the average value of the true synodic period. As will be explained below, even greater accuracy was achieved by applying a correction on successive passes through the table. But the times allotted to the apparitions of the planet between heliacal rises are much less accurate. For example, [in modern times] Venus is morning star for an average of 263 days, rather than the 236 days allotted in the table."[9]

Ancient Hindu astronomic writings preserve a record of the movements of Venus, as quoted from the ancient prose text of the sage Parashara, according to which Venus is seen as the morning star for 270 days in the east (as opposed to a modern value of 263 days), is invisible for an average of 68 days (versus 50 days according to modern observation), then appears in the west as the evening star for 240 days (as compared to 263 days again in modern times), then disappears again for 13 days before rising again in the east (this compared to 8 days in modern times). This amounts to a total Venus period of 591 days for ancient Hindu astronomers compared with a total of 584 days in modern times.[10]

Given the discrepancies that have been noted—here and by Immanuel Velikovsky—in the records of culture after ancient culture, it seems fair to say that notable differences exist between every known ancient table of the movements of Venus and modern observations. Had Venus quietly traversed its same unchanging orbit during these many millennia, it seems reasonable for us to expect to see close agreement with the sightings in at least one of these tables. While these unreconciled differences fall short of categoric proof that a young Venus must have roamed from its current orbit, we can certainly say that they leave the door open to such a possibility.

7

COULD VENUS HAVE BEEN EJECTED FROM JUPITER?

Velikovsky's scenario for the birth of Venus flies in the face of the traditional scientific view that planetary matter accreted from material in the primordial cloud that surrounded the sun after its formation, however it is interesting to note that none of Velikovsky's leading critics ever seems to have raised this point against him. The idea that a planet such as Venus could possibly be "born" from primordial material held in reserve in the form of a gas giant planet might seem at first like a rather whimsical notion, at least until we better understand the kinds of deeply rooted flaws that appear to exist in the two prevailing theories of planetary formation. The 1982 *Encyclopedia Britannica Macropedia* states, "It should be emphasized that no theory of the origin of the solar system has yet won general acceptance. All involve highly improbable assumptions. But the difficulty is in trying to find a theory with any degree of probability at all."[1]

What goes unspoken in the debate between Velikovsky and more traditional scientists is the hushed prospect that Velikovsky's scenario for the origin of Venus may, in fact, be no less likely than any of the traditional theories. Imagine for a moment that planets are typically born by ejection by some unknown process from gas giants. This theory would seem to be consistent with what we have actually found while researching solar systems outside of our own, which minimally consist of either two stars locked in a binary relationship or a star and a gas giant planet. Although some systems have been found that, like our solar system, include several smaller planets, these always appear to exist in the context of at least one gas giant.

One pivot point for Velikovsky's thesis, upon which his broader theory might be largely affirmed or disproved, rests with the planet Jupiter. This point hangs on the question of whether a scenario will ultimately emerge that can credibly explain the ejection of a body as large as Venus from the

massive gas giant planet Jupiter. Velikovsky wrote the following in an article called “My Challenge to Conventional Views in Science,” which he presented to the AAAS 1974 symposium:

> There are problems requiring study that were not discussed in *Worlds in Collision* because the origin of Venus belongs to the volumes dealing with the earlier catastrophes. How did Venus, in Latin, “the Newcomer,” escape from Jupiter four hundred times more massive?—and Lyttleton’s work gives some idea; or how could Venus be so much heavier per unit of volume than Jupiter?—either it was expelled from inner parts of the giant planet, or gases like hydrogen entered into chemical compounds of higher molecular weight. In *Worlds in Collision* I suggested that electrical discharges in the atmosphere of ammonia and methane in which Jupiter is rich, would produce hydrocarbons of heavy molecular weight—an experiment successfully performed ten years later by A. T. Wilson. Further, I envisaged fusion of elements—like oxygen to sulphur—in interplanetary discharges.[2]

Carl Sagan, in his book *Broca’s Brain*, calculated the amount of energy that would be required to eject a Venus-sized body from Jupiter. He concluded that the energy would be enough to vaporize portions of Jupiter. Likewise, Sagan claimed that the vaporized material would have become so intensely hot that it would still remain extremely hot, even today. These same calculations were presented in a paper by Sagan at the 1974 American Association for the Advancement of Science (AAAS) symposium in San Francisco, which was later published in the book *Scientists Confront Velikovsky*. Sagan wrote, “Any event which would have ejected a comet or a planet from Jupiter would have brought it to a temperature of at least several thousand degrees and . . . would have completely melted it.”[3]

Sagan also cited the velocities in kilometers per second that would be required to escape the gravitational pulls of Jupiter (70 km/sec, although Velikovsky later corrected Sagan, pointing out that the true value would be somewhat lower) and of the sun itself at the distance of Jupiter’s orbit (20 km/sec). Sagan then argued against the slim possibility that a cataclysmic event could have occurred for Jupiter that would have accelerated material to a speed just sufficient to escape Jupiter but not so much as to escape from the

solar system entirely, concluding that this made Velikovsky’s scenario untenable.[4]

However, the fallacy in Sagan’s argument can be readily seen if we adopt a similar approach when discussing well-accepted theories of astronomy, such as the formation of the moon. Scientists today realize that all life on our planet owes its existence to the very fortuitous size and mass of the moon and the relative distance and speed of its orbit in relation to Earth. One could argue that the chances of our moon forming in just such a way as to meet all of these specific requirements for life would be, in retrospect, so very slim that life should never have evolved here. Clearly, Sagan must have understood that the likeliest theory cannot necessarily be argued to be the correct scientific one and that any argument that is based on retroactive calculation of probability is prone to be spurious. Another excellent counterexample would be the formation of the universe itself, which rests on miniscule differences in the uniform distribution and temperature of matter in order to account for the formation of the many galaxies and stars in the specific form we see. If we allow Sagan’s brand of logic in our discussion, we can effectively argue that the universe itself cannot reasonably exist.

Sagan also argued that Venus as we know it could not have been formed from the atmosphere of Jupiter. At the time Velikovsky first wrote, the best that scientists of the 1950s could do was make educated guesses as to the likely composition of the atmosphere of Jupiter, so there were no guarantees that its actual composition would ultimately be found to support Velikovsky’s views. However, since 1950, the United States has sent six probes to Jupiter that have returned data on many different aspects of the planet. Based on the findings of those probes, most scientists today understand that the atmosphere of Jupiter does contain the raw materials required to form a planet like Venus. Most scientists now consider the atmosphere of Jupiter to be a well-preserved remnant of the primordial cloud —the nebula from which the planets and other bodies of the solar system initially formed. A NASA website states, “Almost every clue about the materials from which our planet formed, and the processes that turned a primordial cloud of gas and dust into a sun, nine planets and numerous moons, asteroids and comets, has been erased. But the atmosphere of Jupiter is a nearly pristine sample of that primordial cloud.”[5] It is now apparent that

any astronomic body that could have reasonably formed from the primordial cloud might also reasonably form from the reserve of primordial material that is thought to compose Jupiter.

If we entertain Velikovsky's scenario in which Venus was ejected from Jupiter, his inference that hydrocarbons may have contributed significantly to the atmosphere of the comet Venus could theoretically be supported by recent findings on Jupiter. A 1997 summary of the components of Jupiter's atmosphere, written by Steven Dutch, a professor of natural and applied sciences at the University of Wisconsin, and based on the findings of the Casini probe states, "Jupiter is entirely covered with cloud bands. The clouds are made of water ice, ammonia ice, ammonium hydrosulfide (HN_4SH) and hydrocarbons."[6]

For the average person who has no real educational background in astronomy, perhaps the most familiar attribute of Jupiter is the Great Red Spot, which often appears as a dominant feature in photographs of the planet. However, according to another article from NASA, this spot is rivaled by the ephemeral Great Dark Spot, which is twice as big as Earth, a great vortex that swirls around Jupiter's North Pole and that can appear and disappear. The article states:

> "High-energy electrons that hit Jupiter's atmosphere not only cause auroras, but also break apart methane (CH_4), which is more abundant on Jupiter than it is on Earth," says West. "Fragments of methane molecules combine with ambient hydrogen to form acetylene C_2H_2. That's the basic building block. Acetylene combines with other carbon- and hydrogen-containing molecules to build even more complex molecules, which eventually condense into dark droplets." If West is right, the Great Dark Spot is a haze of hydrocarbon-rich droplets floating in the uppermost layers of Jupiter's stratosphere. Such a haze would be prominent in UV images because hydrocarbon droplets are strong absorbers of UV radiation. Indeed, the Great Dark Spot is invisible to the human eye. "It can only be seen in UV light."[7]

As we have mentioned previously, according to the ancient Greek myths to which Velikovsky refers when discussing the birth of Venus, the comet

Venus was ejected shortly after Metis, the pregnant mother of Pallas Athena (Venus), was swallowed whole by Zeus (Jupiter). Until very recently, this mythical scenario was thought to bear no factual relationship to astronomic science as it pertains to our solar system or to the planet Jupiter. However, an August 2010 article in *New Scientist* magazine by science reporter David Shiga suggests that important mysterious physical properties of Jupiter not only support specific details of the myth, but actually invite us to believe that just such a scenario may well have occurred.

> Jupiter and Saturn are thought to have begun life as rocky worlds with the mass of at least a few Earths. Their gravity then pulled in gas from their birth nebula, giving them dense atmospheres. In this picture, all gas giants should have cores of roughly the same size. Yet spacecraft-based gravity measurements suggest Jupiter's core weighs just two to 10 Earth masses, while Saturn's comes in at 15 to 30. New simulations by Shu Lin Li of Peking University in China, and colleagues, may explain why. They calculated what would happen when a super-Earth of 10 times the mass of our planet slammed into a gas giant. The rocky body flattened like a pancake when it hit the gas giant's atmosphere, then barrelled into the giant's core about half an hour later. The energy of the collision could have vaporised much of the core. These vaporised heavy elements would then have mixed with the hydrogen and helium of the gas giant's atmosphere, leaving only a fraction of the gas giant's former core behind. This could explain not only why Jupiter's core is so small, but also why its atmosphere is richer in heavy elements compared with the sun, whose composition is thought to mirror that of the nebula that gave birth to the solar system's planets.[8]

Just as Sagan calculated when making his arguments against Velikovsky, the impact scenario proposed by Shu Lin Li would have generated energies sufficient to vaporize the core of Jupiter, which is envisioned to have originally been comparable in size to the larger cores of other gas giants. Likewise, models suggest that the impact would have left Jupiter with the much smaller core it currently has, which continues to be—as Sagan surmised it would become—intensely hot. NASA estimates the core temperature of Jupiter to be 23,871 Celsius (43,000 degrees Fahrenheit),

almost twice as hot as the core of Saturn and even hotter than the surface of the sun.[9]

It seems somewhat more than ironic that Sagan's calculations, which he proffered as a way of illustrating the gross untenability of Velikovsky's scenario for the birth of Venus, might in the end serve as points of reference by which Shu Lin Li's model can be effectively correlated to Velikovsky's scenario.

If we were looking for a mechanism by which material within Jupiter's atmosphere might theoretically have been collected, cohered, and transported into space and away from Jupiter, we would need look no further than Jupiter's Great Red Spot, the mammoth perpetual storm that is thought by some scientists to be a permanent feature of the Jovian atmosphere. Findings made by the most recent probes to Jupiter suggest that this gigantic storm, which measures three Earths in diameter at its largest point, serves as a kind of atmospheric dumbwaiter, capable of shuttling superheated material from near the core of Jupiter to the dramatically cooler uppermost reaches of its atmosphere. One web-based article tells us, "Scientists think the Great Red Spot has its characteristic red color because the strength of the storm is digging down into Jupiter's atmosphere, bringing complex organic molecules to the high atmosphere."[10]

Another web source includes the following statement:

> The atmospheres of both Saturn and Jupiter are highly dynamic. The activity in their atmospheres is represented by eddy and storm structures seen on their surfaces. Long-lived oval structures in Jupiter display clockwise rotations at the northern hemisphere and are therefore high pressure storm systems. These oval structures tend to disappear within the jet system of the planet or merge with the bigger features, such as the Great Red Spot. In Saturn, storm structures erupt almost every 30 years, but the mechanism triggering these is still unknown. Surprisingly, the jet systems and other features, such as the Great Red Spot of Jupiter, are able to remain in such an active atmosphere. This is probably because the mass of the jets is bigger than that of eddies, but this is only possible if the roots of these circulations extend to great depths. Theories suggest that the liquid interior also rotates with them, creating roots that extend

all the way to the core of the planet.[11]

One can easily imagine, based on the models of Shu Lin Li, that the explosive force caused by the impact with Jupiter of a body ten times the size of Earth, which was ostensibly powerful enough to vaporize the solid core of Jupiter, would also be strong enough—perhaps with the added assist of the upward circulating flow of the Great Red Spot—to eject a coherent body of primordial material into space at speeds capable of overcoming the gravitational pull of the gas giant.

Another argument presented by Sagan against Velikovsky in regard to the ejection of Venus from Jupiter, which he expressed at the AAAS symposium, is that from an astronomic perspective, “Any process which makes large objects makes more small objects.”[12] It was also Velikovsky’s view that the processes that he postulated to have created Venus from Jupiter actually did create a large number of additional smaller objects, including many of the short-period comets. (In all, about 1,600 smaller bodies have been documented to share Jupiter’s orbit.) Velikovsky cited studies by a leading Russian authority on comets named S. K. Vsekhsviatsky, whose research revealed that a large number of short-period comets were losing mass at such a very high rate that they were calculated to completely disappear within fifty or sixty orbits, so they could not be of a very great astronomic age. This suggested that objects such as Halley’s Comet also could not have been created more than a few thousand years ago.[13] In Velikovsky’s view, the creation of many smaller bodies accompanied the ejection of Venus from Jupiter. This result was supported, in Velikovsky’s view, by the seemingly large number of comet sightings reported in ancient times as opposed to modern-day sightings.

8

COULD VENUS HAVE MADE A CLOSE APPROACH TO EARTH?

According to the traditional scientific view, Venus and Earth formed at the same time billions of years ago and have since remained in their distinct, separate orbits, with no reasonable opportunity to have made a close encounter with one another. For us to entertain a possibility that Venus made a close approach to Earth, we would need to cite evidence that could be interpreted as having directly resulted from that encounter. Likewise, we need to reexamine any of Velikovsky’s predictive statements that relate to this ostensible encounter and attempt to evaluate those against recent scientific findings.

Perhaps the first point to be made regarding Venus and Earth is that Velikovsky critic Carl Sagan seems justified in his view, in regard to the biblical “long day of Joshua,” that it would be unreasonable to think that any interaction between Venus and Earth could have at first greatly slowed the physical rotation of Earth and then somehow restarted it again, magically returning it to the same approximate original rotational speed. Velikovsky’s answer to this complaint is that, from the standpoint of a person on Earth, a similar effect could have been accomplished through a gradual change in the tilt of the axis of Earth—an event that would have required no actual change in the Earth’s rotational speed at all and which could also have had the effect of greatly elongating the day for some viewers.

As the most obvious starting point for discussing new evidence that might pertain to this, it is now accepted, as we have previously mentioned, that there is an apparent rotational resonance that, for reasons unknown, exists between Venus and Earth. Through the auspices of this apparent resonance, Venus turns its same face to Earth at every inferior conjunction. Some think that this resonance, which is typical of the kind that develops between astronomic bodies that have, in fact, approached each other, could be the

remnant of a close encounter between Venus and Earth, such as Velikovsky suggests. Others have argued that it might indicate that Earth's gravitation exerts a subtle tug on Venus. However, this second proposition was rejected by many astronomers when it was calculated that the combined spin of the two planets was too rapid for such a subtle gravitational effect to actually work.

Velikovsky claimed, as we again alluded to earlier, that as Venus passed nearby Earth, the two bodies influenced each other's rotation. As a consequence of this (and of a proposed impact between Venus and Mars) Velikovsky predicted that Venus would be found to have an anomalous rotation. Later it was shown that Venus did, in fact, exhibit a very slow and retrograde rotation (meaning that it rotates in the opposite direction to Earth). Both of these facts could be interpreted to support Velikovsky's claim of a close encounter between Venus and Earth.

In 2010, Gerard Caudal of the University of Versailles-Saint Quentin in France proposed another theory in which, despite their spin, a gravitational lock might still exist between the cores of the two planets that would be capable of explaining the resonance. However this theory requires that Venus have a solid core within a liquid core (recent evidence suggests that the core of Venus may be entirely liquid)[1] and that the core of Venus be asymmetric—a suggestion that seems unlikely given the very high temperature of Venus's core and the very great internal pressures involved.[2]

Velikovsky claimed—and it has not been reasonably disputed—that any close approach of Venus to Earth would have caused major geological upheaval on Earth and so should be reflected in the volcanic activity of the period. This implies that we should find evidence either of unusually powerful eruptions or of an unusual increase in the number of eruptions at around the time of the encounter. The Global Volcanism Program, which operates under the auspices of the Smithsonian Institution's National Museum of Natural History, has compiled a list of known historical eruptions, along with the estimated dates at which they occurred (as determined and often reconfirmed by radiocarbon dating). Also included is the estimated intensity of each eruption, rated from 1 to 8 on the Volcanic Explosive Intensity (VEI) scale. Each sequential number on the scale represents an event another ten times as powerful as the prior number.

As a real-world point of reference to put the scale in context, we are told that the 1980 eruption of Mount St. Helens in Washington State is rated at 5, while the ancient massive eruption at Santorini (estimated to be one hundred times as powerful and thought to be one of the most powerful eruptions ever to occur on Earth) is rated at 7. The table reflects only major events, which means that it includes only those rated at a VEI of 4 or above. Of course, in more recent times every eruption has been faithfully measured and recorded, whereas records of ancient eruptions are only fragmentary, so some that occurred may not be reflected in the table. Also, many of the inferred dates for ancient eruptions may have changed somewhat since 1950, when Velikovsky developed his chronology. In any case, we can see that the period identified by Velikovsky for the ostensible approach of Venus to Earth—the time of the eruption of Thera on the island of Santorini—includes both the largest single volcanic eruption ever known and a record of widespread significant volcanic eruptions evidenced from the Mediterranean to Iceland, North America, Central America, South America, New Zealand, Japan, and Russia.[3]

MAJOR VOLCANIC ERUPTIONS AT OR AROUND 1600 BCE

VOLCANO	VOLCANIC SUBREGION	CODE	DATE (REVERSE ORDER)	(VEI) VOLCANIC EXPLOSIVE INDEX
Vesuvius	Italy	G	1430 BCE ± 300 years	4
Katla	Southern Iceland	G	1440 BCE ± 40 years	4
Arenal	Costa Rica	T	1450 BCE (?)	4
Taupo	New Zealand	G	1460 BCE ± 40 years	6
Etna	Italy		1500 BCE ± 50 years	5?
Ibusuki Volc Field	Kyushu (Japan)	T	1500 BCE (?)	4
Avachinsky	Kamchatka Peninsula (Russia)	G	1500 BCE (?)	5
Hekla	Southern Iceland	T	1550 BCE (?)	4
Vesuvius	Italy	G	1550 BCE ± 75 years	4
Hayes	Southwestern Alaska	T	1550 BCE (?)	5
Santorini	Greece	G	1610 BCE ± 14 years	7?

Aniakchak	Alaska Peninsula	I	1645 BCE ± 10 years	6?
Arenal	Costa Rica	T	1650 BCE (?)	4
Campi Flegrei	Italy	T	1650 BCE (?)	4
Aso	Kyushu (Japan)	G	1700 BCE ± 50 years	P
Shiveluch	Kamchatka Peninsula (Russia)	T	1700 BCE (?)	4
Taranaki [Egmont]	New Zealand	C	1700 BCE ± 100 years	5
Veniaminof	Alaska Peninsula	C	1750 BCE (?)	6
Okataina	New Zealand	G	1750 BCE (?)	4+
St. Helens	Washington State (USA)	T	1770 BCE ± 100 years	5
Ibusuki Volc Field	Kyushu (Japan)	T	1780 BCE (?)	4
Villarrica	Central Chile	C	1810 BCE ± 200 years	5
Rincon De La Vieja	Costa Rica	G	1820 BCE ± 150 years	G

Codes:
C = carbon-14 (uncorrected) P = Plinian eruption, VEI uncertain
G = carbon-14 (corrected) T = tephrochronology

A "?" accompanies those VEIs that were particularly difficult to assign, and those that are based on purely circumstantial evidence. For example, a VEI of 1? might have been assigned to an undescribed eruption because a nearby contemporaneous eruption received sufficient historical comment to confidently assign a VEI of 2. When there was simply no evidence on which to base a VEI, this column has normally been left empty (20 percent of the eruptions in our file).

A "+" following a VEI indicates an eruption volume in the upper third of the range for that particular VEI designation. It shows those eruptions known to be larger than most others sharing the same VEI numeral, but its absence does not necessarily indicate a relatively small event. The designation is used only for VEIs > 4, volume data permit adding it to only 22 events globally, but it is helpful to identify the obviously larger events in volume ranges that span a full order of magnitude.

Eruptions associated with caldera collapse are normally large (probably VEI >4), and those for

which data are lacking to assign a specific VEI are indicated by a "C" in the VEI column. Likewise, Plinian eruptions in the absence of more quantitative data are marked with a "P" in the VEI column.

Eruptions that were definitely explosive, but lack other descriptive information to assess their magnitude, have been assigned a default VEI of 2, that of "moderate" eruptions. Conversely, other eruptions in which substantial tephra volumes were accumulated over long periods of time and/or much of the tephra volume was in near-vent cone construction, have been downgraded by one VEI unit.

Velikovsky claimed that the close approach of Venus to Earth would have made thermal, chemical, and electromagnetic changes in the moon. If, in fact, Venus and Mars did make close approaches to Earth and the moon and precipitated the kinds of exchanges that Velikovsky proposes, then the effects of those exchanges should be evident in recent studies of the moon. These studies began with the *Apollo* missions of the late 1960s and ended with a 2009 lunar mission whose purpose was to positively demonstrate whether water might exist on the moon.

Perhaps the first of Velikovsky's predictive statements relating to the moon was that Earth would be found to have a magnetic field that extends as far as the moon. The discovery of the magnetosphere by James Van Allen confirmed the existence of the magnetic field itself. Recent studies emphasize how far into space this field can actually stretch. A 2008 article in *Science Daily* magazine titled "Moon Gets a Lashing from Earth's Magnetotail" confirms Velikovsky's suggestion that this field must extend as far as the moon to have been a correct one.

> Yes, Earth does have a magnetic tail. It is an extension of the same familiar magnetic field we experience when using a Boy Scout compass to find our way around Earth's surface. Our entire planet is enveloped in a bubble of magnetism, which springs from a molten dynamo in Earth's core. Out in space, the solar wind presses against this bubble and stretches it, creating a long "magnetotail" in the downwind direction. Anyone can tell when the moon is inside the magnetotail.
>
> Just look: "If the moon is full, it is inside the magnetotail," says [Tim] Stubbs [a University of Maryland scientist]. "The moon enters the magnetotail three days before it is full and takes about six days to cross and exit on the other side.[4]

Another of Velikovsky's early "expectations" regarding the moon relates to this same concept of magnetism and how it affects bodies of the solar system. Because the moon has no magnetic field of its own, none could have been present to affect the rocks at the time they are presumed to have formed billions of years ago, having cooled from molten lava. Consequently, the reasonable expectation of astronomers in the 1950s and 1960s was that moon rocks would exhibit no magnetism. However, based on Velikovsky's proposed history for Venus and Mars, the moon would have been recently exposed to the magnetic fields of Mars and Venus and to high temperatures that would have caused widespread melting of the moon's surface. From Velikovsky's perspective, many of the moon rocks should exhibit some degree of remnant magnetism. Accordingly, one mystery that was raised initially by the moon rocks when they were returned by the *Apollo* astronauts was why they did, indeed, often show signs of remnant magnetism.

In 2009, Dr. Thomas Bell, a geologist from the University of California at Berkeley who was familiar with the study of moon rocks, stated, "Many but not all lunar rocks have no remnant magnetism. Remnant magnetism is created when molten rocks cool and iron bearing minerals form and align themselves parallel to a planetary magnetic field. The oldest lunar samples do indeed have remnant magnetism and this may indicate the Moon once had a magnetic field. Other lunar rocks have what may be 'shock' induced remnant magnetism induced by impacts to the lunar surface and local melting of the crust. Most lunar rocks have extremely weak or no remnant magnetism because the Moon does not have a magnetic field."[5]

Other modern sources consider the issue of remnant magnetism on the moon to be an unsolved mystery. One NASA website mentions this issue, stating, "Though the Moon has no internally generated magnetic field, areas of magnetism are preserved in the lunar crust, but how this occurred is a mystery. The early Moon appears not to have had the right conditions to develop an internal dynamo, the mechanism for global magnetic fields for the terrestrial planets."[6]

In light of the great heat that would have been generated by the theoretic close approaches of Venus and Mars and the consequent widespread melting of the surface of the moon, Velikovsky's outlook was that probes would eventually find that lava had recently flowed and bubbled on the surface of

the moon. Studies of the *Apollo* moon rocks bear out the notion that these rocks were created by great melting, however the many different (and sometimes self-contradictory) dating techniques used to establish the age of these rocks reportedly show them to be much older than Velikovsky's theory would predict. A National Air and Space Museum article titled "Top Ten Scientific Discoveries Made during Apollo Exploration of the Moon" states, "The youngest Moon rocks are virtually as old as the oldest Earth rocks. . . . All Moon rocks originated through high-temperature processes. . . . Early in its history, the Moon was melted to great depths to form a 'magma ocean.' . . . The lunar magma ocean was followed by a series of huge asteroid impacts that created basins which were later filled by lava flows."[7]

However, NASA itself admits to wide, unexplained anomalies in the calculated ages of moon rocks as determined by their various dating techniques (although none were calculated to be as recent as Velikovsky's scenario would suggest), often with the results of one dating technique directly contradicting those of another for the same rock. Studies show widespread evidence that younger highland rocks may have been "totally or partially reset during heating by large impacts."[8]

The inherent difficulties in trying to establish radiometric dates for rocks whose composition at the time of formation is not firmly known are outlined in a 2008 article by Mitsunobu Tatsumoto, Dr Andrew A. Snelling, and David E. Rush of the Department of Physics at the Indonesia University of Education. The article states:

> If we know the amount of uranium and lead in a rock, can we tell how old it is? We can if we know how much uranium and lead were in the rock to begin with. [Otherwise] we can make one of two assumptions. (1) There was some lead in the rock when it was formed. (2) There wasn't any lead in the rock when it was formed. If we make the first assumption, then we have to figure out how much there was. Since scientists don't know what process formed the rock in the first place, we can't possibly know how much uranium and how much lead that process created. Therefore, the accuracy of the computed date depends entirely upon how well we guess the initial concentrations of uranium and lead. There is no more reason to believe that the rock initially contained 20% uranium and

> 80% lead than there is to believe that the rock initially contained 80% uranium and 20% lead. If you assume an initial concentration of each kind of material, the calculations will yield an age determined entirely by whatever wild guess you make. If we make the second assumption, the calculation will yield the oldest possible age. . . . If one uses three different dating techniques on two different rocks from the same rock formation, it is quite possible that one will get six different dates. If one uses Potassium/Argon and Lead/Lead on the same rock, the Potassium/Argon date will probably be millions of years while the Lead/Lead date will probably be billions of years. Geologists know this, so they never bother to do Lead/Lead dating on recent lava flow, nor do they do Potassium/Argon on "ancient" gneiss. Whenever a radioactive date calculation does not agree with the preconceived notion of how old the rock is, that date is declared "discordant" and is ignored.[9]

In essence, because modern-day astronomic theory has not firmly established how, when, or under what precise circumstances the moon was formed, it becomes problematic to guesstimate what their original chemical composition may have been. Because of this, attempts to establish the age of moon rocks based on radiometric dating may in fact be an essentially arbitrary process whose method only serves to uphold preconceived expectations of the moon's age. Under such circumstances, the statement that a given moon rock is likely to be a billion years old becomes essentially meaningless.

Other researchers report an excess of noble gas atoms in the outer layers of lunar rocks—such as Velikovsky suggested might have been acquired from a close approach of Mars—whose presence and method of distribution is not well understood. They write, "Analysis of noble gases in the first lunar materials returned from the moon showed noble gas atoms are extremely abundant in lunar soils and led to a variety of conclusions relating to the source of the gases and mechanisms controlling their subsequent distribution. . . . Based on etching experiments and analysis of various grain-size fractions, gases were found to reside near the surface of grains, mostly in the outermost few tenths of a micron."[10]

Even if it seems that the age of moon rocks cannot be used definitively to

help confirm or deny Velikovsky's thesis, there are other interesting features called *rilles* (long sinuous ridges or valleys) whose existence on the moon has been difficult to explain without evoking another specific aspect of his scenario—in this case, Velikovsky's presumption that great electrical discharges occurred between bodies at the time of the close approach to Earth of Venus and Mars. One article states:

> The surface of the moon is replete with long channels or grooves that continue to create unsolved puzzles and contradictions for geologists. Every traditional theory, when tested against the photographic evidence, has failed. . . . One explanation of Hadley and other lunar rilles has yet to be considered by planetary scientists. It is the one explanation that does not produce contradictions, or conflict in any way with what we see on the moon. Engineer Ralph Juergens, who investigated a new approach to sinuous rilles, suggested in 1974 that they are the effects of "electrical discharge." Juergens' work, in turn, helped to inspire the lifelong explorations of today's leading electrical theorist, Wallace Thornhill, who has taken the investigation into new areas of research opened up by more recent explorations of our planetary neighbors. . . . Juergens knew that an electric discharge of the magnitude implied would require an approaching charged body—and not just a small rock but another planet or moon. "The electric field between anode and cathode [positively and negatively charged bodies] must build to an intensity great enough to 'pull' electrons from the cathode by sheer force, . . . tearing electrons from non-conducting lunar crustal materials and in numbers sufficient to trigger an interplanetary discharge."[11]

It was Velikovsky's confirmed view that hydrocarbons, which he correctly hypothesized must constitute a part of the atmosphere of Jupiter, would have been carried in the cometary tail of Venus. As a consequence, he supposed that evidence of hydrocarbons would be found on the moon. A 1970 *Science* magazine article titled "Organic Compounds in Lunar Samples: Pyrolysis Products, Hydrocarbons, Amino Acids" appears to confirm this prediction.[12]

In 1977, late in Velikovsky's life, he summarized his predictions about what would be found to be true about the moon based on the requirements of his thesis in *Worlds in Collision* and compared those predictions to what had

actually been shown to be true about the moon during the moon missions of the 1960s and early 1970s. He wrote in an article titled, "My Challenge to Conventional Views in Science":

> Orbiter and Surveyor probes of the Moon were followed by Apollo probes; and on the historic night of July 21, 1969, when Man stepped on the Moon, I made a series of claims in an article written at the invitation of the *New York Times,* and spelled out earlier as well in memos to the Space Science Board of the National Academy of Sciences. Strong magnetic remanence, I claimed, would be discovered in lunar rocks and lavas, though the Moon itself hardly possesses any magnetic field whatsoever. A steep thermal gradient would be found already a few feet under the surface. Thermoluminescence would disclose that the Moon was heated considerably only thousands of years ago. Hydrocarbons, preferably of aromatic structure, would be found in small quantities, but carbides, into which hydrocarbons would transform when heated, in substantial quantities; expressed radioactivity would be detected in lunar soil and rocks; and several more claims. Already following Apollo XI and XII the score was complete. But each of the discoveries—steep thermal gradient, strong remnant magnetism, recent heating of the lunar surface, carbides and traces of aromatic hydrocarbons, and rich radioactivity of the rocks and dust—evoked exclamations of surprise and at best some far fetched, *ad hoc* hypotheses. Magnetic anomalies, especially where interplanetary bolts fell, and huge enclaves of neon and argon 40 in lunar rocks, were also claimed by me in advance of the findings.[13]

Velikovsky realized that one likely consequence of the close approach of a body like Venus to the moon is that great heat would have been generated, which should be reflected in evidence of volcanic activity on the moon and is in fact in accordance with the discovery that many of the surface moon rocks have been subjected to great heating and melting at some point in their history. Velikovsky suggested that at least some of the many craters of the moon would be found to be the product of the bursting of bubbles of lava. A 2010 report by Southern California Public Radio on findings by the Lunar Reconnaissance Orbiter, titled "New Findings Show Moon's Geologic Past

More Complicated than Previously Thought," supports this possibility.

> Some of the data comes from the Diviner Lunar Radiometer Experiment on board the Orbiter. It makes infrared maps of the lunar surface—and studies those maps to detect various minerals. Three UCLA scientists have examined the Diviner data; they say it reveals geologic structures on the Moon linked with volcanic activity. There are steep slopes and rough surfaces that suggest lava bubbled up and bulged out the surface. The Diviner's reading of materials blasted out of craters also suggests that in some places, lava pooled and cooled beneath the surface. What it all means is that lunar geology is far more complex than researchers had thought.[14]

Perhaps the most controversial of Velikovsky's predictions was that water would be found on the moon—more specifically, just under the surface of the moon. When discussing this prediction with his friend Harry Hammond Hess, who had carefully followed the evolving record of Velikovsky's "expectations," or predictions, Hess flatly declared, "This time you will be wrong."[15] However, in October 2009, when NASA's LCROSS Lunar Impactor mission deliberately smashed a spent booster rocket into a permanently shadowed crater of the moon, the results showed significant amounts of water to exist in the form of ice, located (as Velikovsky had surmised) just below the surface of the moon.[16]

9

COULD VENUS HAVE IMPACTED MARS?

Another of the bold predictions made by Velikovsky in *Worlds in Collision*, based on what he saw as the corroborating evidence of world mythologies, was that Mars had suffered a direct impact from the comet Venus, a collision that, in Velikovsky's view, had occurred sometime prior to 757 BCE and put Mars on its own path of destructive interludes with Earth. Again, this predictive statement, which was given by Velikovsky in 1950, ran counter to the conventional wisdom of the day, and it was made largely on the testimony of ancient world mythologies and without the benefit of much supporting scientific evidence. However, in the 1970s when the Viking space probes began to reach Mars, a picture of the planet began to emerge that largely supported Velikovsky's view. Twenty years later, the Mars Global Surveyor probe showed that the crust of Mars is much thicker in the Southern Hemisphere of the planet than in the Northern Hemisphere. It also revealed differences in the magnetic properties of the Northern and Southern hemispheres of Mars. It was suggested that these characteristics might relate to an internal process within the planet or could possibly be interpreted as surviving evidence of one or more ancient impacts.

In 2008, a study at the California Institute of Technology (Cal-Tech) by Margarita Marinova, then a graduate student in Cal-Tech's Division of Geological and Planetary Sciences (GPS), confirmed that Velikovsky's proposed planetary impact scenario could make sense in terms of the types of damage that had been observed to exist on Mars. It is important to note that, after many trials based on widely varying parameters, the scenario favored by the researchers attributed the impact to a body much smaller than Venus and assigned it to an epoch much earlier than Velikovsky proposes. A Cal-Tech press release states:

> Scientists at the California Institute of Technology have shown through computer modeling that the Mars dichotomy, as the divided terrain has

> been termed, can indeed be explained by one giant impact early in the planet's history. . . . This size range of impacts only occurred early in solar system history. . . . The team modeled a range of projectile parameters that could yield a cavity the size and ellipticity of the Mars lowlands without melting the whole planet or making a crater rim. . . . After cranking 500 simulations combining various energies, velocities, and impact angles through the GPS division's Beowulf-class computer cluster CITerra, the researchers narrowed in on a "sweet spot"—a range of single-impact parameters that would make exactly the type of crater found on Mars. . . . The favored simulation conditions outlined by the sweet spot suggest an impact energy of around 10 to the 29 joules, which is equivalent to 100 billion gigatons of TNT. The impactor would have hit Mars at an angle between 30 and 60 degrees while traveling at 6 to 10 kilometers per second. By combining these factors, Marinova calculated that the projectile was roughly 1,600 to 2,700 kilometers across.[1]

The statement makes clear that the tentative dating of the impact was not based on any actual physical evidence, but rather on the traditional scientific view that our solar system has long been a place of tranquility and the assumption that, therefore, any major upheaval within the solar system must have happened millions or billions of years ago. The Cal-Tech announcement does not say whether any simulations were run based on possible impact with a body the size of Venus or whether any of them might have produced results similar to what is seen on Mars.

Another statement taken from the Cal-Tech press release and speaking in regard to the same study provides us with a qualitative reference to a likely range of sizes for the body thought to have impacted Mars. This reckoning suggests that a body the size of Mars—6,800 kilometers in diameter, the approximate size of the body thought to have been responsible for the creation of Earth's moon—could have been involved. Venus, whose diameter measures 7,257 kilometers, is only slightly larger than Mars, and so might reasonably fall within the projected range. The press release states, "Estimates of the energy of the Mars impact place it squarely between the impact that is thought to have led to the extinction of dinosaurs on Earth 65 million years ago and the one believed to have extruded our planet's moon four billion years ago."

Another source commented on the importance of the impact model for understanding the history of Mars.

> "This impact is really one of the defining events in Mars' history," said MIT postdoctoral researcher Jeffrey Andrews-Hanna, who led the new study with MIT geophysicist Maria Zuber and NASA Jet Propulsion Laboratory researcher Bruce Banerdt. By combining detailed topographical data from the Mars Global Surveyor mission with measurements of the variations in the planet's gravitational field made by the Mars Reconnaissance Orbiter satellite, Andrews-Hanna and his team assembled a map of the Martian surface before volcanic eruptions added layers and obscured the boundary between the hemispheres. The map revealed a stunning elliptical basin shape covering about 40 percent of Mars' surface. "This was a kind of surprising result," Andrews-Hanna said. "What we noticed is that the dichotomy boundary around the planet was actually smooth and regular. We tested to see if we could fit this with any shape, and it just so happens that it's almost perfectly fitted by an ellipse. There's only one process that's known to make an elliptical depression like that, and that's a giant impact."[2]

Through a variety of inferences, Velikovsky made certain predictions about the likely chemical composition of the atmosphere on Mars. Based on these inferences, he concluded that nitrogen, argon, and/or neon should be found to exist in significant amounts in the atmosphere of Mars. Velikovsky also wrote:

> [Assuming the atmospheres of the earth and Mars intermixed during a close approach to one another], the main ingredients of the atmosphere of Mars must be present in the atmosphere of the earth. . . . As oxygen and water vapor are not the main ingredients of the atmosphere of Mars, some other elements of the terrestrial atmosphere must be the main components of its atmosphere. It could be nitrogen, but the presence of nitrogen on Mars—or its absence—has not yet been established.
>
> Besides oxygen and nitrogen, the main components of the terrestrial atmosphere, argon and neon are present in detectable quantities in the air . . . if analysis [of the Martian atmosphere] should reveal them in rich

amounts, this would also answer the question: What contribution did Mars make to the earth when the two planets came into contact?[3]

Since the time of these prognostications, probes have shown the Martian atmosphere to actually be composed of a variety of elements. These are compared in the table on page 78 to a similar list of elements that make up the atmosphere of Earth.[4]

In *Worlds in Collision*, Velikovsky commented on one of the specific forms that carbon would likely be found to take on Mars. He says, "The white precipitated masses on Mars, which form the polar caps, are probably of the nature of carbon, having been acquired from the trailing part of Venus."[5] Data from the 1976 Viking Landers were used to determine that "the atmospheric pressure on Mars changes seasonally because the temperature is cold enough that some of the carbon dioxide freezes during the winter and 'snows' onto the polar cap."[6]

ATMOSPHERE COMPONENTS OF EARTH AND MARS

MARS ATMOSPHERE COMPONENTS BY VOLUME	EARTH ATMOSPHERE COMPONENTS BY VOLUME
• 95.32 percent carbon dioxide	• 0.035 percent carbon dioxide
• 2.7 percent nitrogen	• 78.1 percent nitrogen
• 1.6 percent argon	• 0.93 percent argon
• 0.13 percent oxygen	• 21 percent oxygen
• 0.021 percent water	• 1 percent water, typically
• 0.0003 percent neon	• 0.0018 percent neon
• 0.08 percent carbon monoxide	
• 0.01 percent nitrogen oxide	

While we've discussed how evidence on Mars supports Velikovsky's notion that Venus and Mars suffered a major impact with each other, there is also recent evidence that Venus may well have also been involved in just such a collision. A 2008 article in *USA Today* under the headline "Venus Mysteries Blamed on Colossal Collision" states:

In a new paper in *Earth and Planetary Science Letters*, John Huw Davies

(Cardiff University) postulates that a giant impact in the late stages of planet formation is responsible for Venus’s hot and dry climate. The impact would have been between two planet-sized objects, not dissimilar to the impact believed to be responsible for the formation of the Earth’s Moon. That latter giant impact, now accepted as the standard model for the origin of the Moon, was off center and resulted in a disk around the proto-Earth and gave the Earth a rapid spin. Davies’ model would have a near-central impact that would leave Venus with virtually no rotation and vaporize any water it might have had at that point.[7]

10

COULD MARS HAVE MADE A CLOSE APPROACH TO EARTH?

Velikovsky blames the direct impact of Venus with Mars for having placed the planet Mars on its own collision course with Earth, sometime in the first millennium BCE. Although the sequence in which Velikovsky presents his chronology in *Worlds in Collision* suggests that the Venus/Mars impact happened *after* the close approach of Venus to Earth, the lingering rotational resonance that seems to exist between Earth and Venus argues that if this collision actually occurred, it must have happened sometime *before* Venus encountered Earth.

It is Velikovsky's claim that, during the final millennium BCE, Mars made repeated close encounters with Earth. Carl Sagan famously calculated the probability of the several close encounters postulated by Velikovsky between Earth, Venus, and Mars at one in 10^{23}. This figure, which was widely quoted in the press as an overwhelming statistic against Velikovsky's view, was based on the assumption that each encounter should be treated as an independent event. However, Velikovsky quickly pointed out—and was later affirmed by Robert Jastrow, the founder and director of NASA's Goddard Institute for Space Studies—that the laws of gravity, in fact, dictate than one such encounter greatly enhances the probability of additional encounters.

Velikovsky cites many disastrous effects that the encounter with Mars ostensibly ravaged on Earth, but the most obvious and perhaps most verifiable of these would be his claim that it lengthened the solar year, extending the widely observed ancient 360-day year to our current 365-day year. Had such an event occurred as Velikovsky claims during historic times, we should see clear evidence of it reflected in the history of calendars worldwide. The presumption is that many of these cultures would report a change in the calendar to accommodate the new length of the year, sometime after 757 BCE, according to Velikovsky's timeline.

Alongside a typical lunar calendar consisting of twelve 29- or 30-day months (totaling 354 days, but extended to 355 in some calendars by the celebration of a new year's day or with an additional intercalated day, it is well documented that many ancient cultures also honored a 360-day calendar that comprised twelve 30-day months. Evidence for a 29-day month in Egypt is supported textually, which implies that Egypt also had a 354- or 355-day lunar calendar. Most modern researchers understand the 360-day calendar as having been for purely civic or ceremonial reasons—reasons that relate to religion and cosmology, not to any actual difference in the length of the solar year. The values that predominated in these ancient calendars center on the numbers 3, 5, 10, 12, 24, 30, 60, 360, and 2,160, all of which are factors of the grand precessional cycle of 25,920 years, so—if knowledge about precession on the part of the ancient Egyptians can be presumed—they can be seen as deliberate approximations. Precession is the long, almost imperceptibly slow progression—traditionally thought to be caused by a slow wobble in Earth's rotation—by which the constellations rotate in their relative positions as they appear to pass behind the morning sunrise. Likewise, Velikovsky's proposition that the length of the year changed appears to be flatly contradicted by the belief of modern historians that the ancient Egyptians and the Chinese observed a 365-day year since very early in their history.

Most Egyptologists believe that, in order to align their 360-day ceremonial/civic calendar with the 365-day year, the Egyptians added five *epagomenal days* to their 360-day ceremonial calendar. These extra days, which fall between the last day of one year and the first day of the next, are referred to as "the days upon the year" and were celebrated as the birthdays of five important Egyptian gods. Symbolically, these days were said to exist outside of any given year or month. Evidence for the addition of these days extends almost to the beginning of the Egyptian civilization—thousands of years before the date that Velikovsky proposes Mars encountered Earth.

The five-day difference between the 360-day ceremonial calendar and the 365-day solar calendar—along with the rationale for inserting extra days into the Egyptian calendar—was explained by way of a legend in which the master of time, Thoth, after creating the 360-day year, deceives Ra (one version of the myth says "the moon") into giving him five extra days on

which the goddess Nut can give birth to her children. Another version of the myth proposes that Thoth won five days from the moon (defined as 1/72 of her days) in a game of draughts. In both versions, the five extra days were added to the Egyptian year and are interpreted by Egyptologists to round out a 360-day year to 365 days.

It's clear that if it can be explicitly shown that the ancient Egyptians observed a 365-day year perhaps as early as 3000 BCE, then a large portion of Velikovsky's thesis simply fails to hold up. However, when we take a closer look at the evidence on which the traditional view of the ancient Egyptian calendar is based, it appears that no explicit textual reference to a 365-day year in Egypt actually exists—only suggestive references that traditional Egyptologists have interpreted to infer the existence of a 365-day year.

The evidence for a 365-day year in Egypt begins with a tablet from the First Dynasty that seems to indicate that the Egyptian year began with the annual heliacal rising of Sothis, or Sirius. This implies that by that early date, the ancient Egyptians used a solar calendar. The unspoken presumption on the part of the traditional Egyptologists is that this was a 365-day solar year, not Velikovsky's theorized 360-day year. Likewise, there are statements in Egyptian texts that the year consisted of "twelve months" plus the five added epagomenal days, but again these do not specify whether they refer to the twelve lunar months that add up to 354 or 355 days or to the twelve ceremonial months that add up to 360 days; both the solar and lunar calendars used the same month names. In other words, it's entirely possible, in accordance with Velikovsky's views, that the five epagomenal days were originally meant to reconcile a 355-day lunar calendar with a 360-day solar calendar. In support of this view, we could refer to Sir E. A. Wallis Budge's *Egyptian Hieroglyphic Dictionary*, whose entries state that one name for the epagomenal days was *renpt*,[1] the same pronunciation that Budge assigns to the festival of the new year and to the shared name of the festivals of both the solar year and the lunar year. In this way, the Egyptian hieroglyphic language suggests that the epagomenal days somehow bore a relationship both to the lunar calendar and the solar calendar.

Another way to cross-check this interpretation of the Egyptian year and their use of the epagomenal days is to review the traditions of the Dogon tribe

of Mali. The Dogon are a modern-day priestly African tribe who seem to still observe many of the same practices as the ancient Egyptians. There are a number of factors that suggest that the societal system preserved by the Dogon represents a very early version of ancient Egyptian culture, such as the presence in Dogon culture of cosmological glyph-like drawings, but without any actual written hieroglyphic language. (The many correlations that seem to exist between the Dogon and ancient Egyptian words, symbols, cosmology, and civic practices are documented in my books *The Science of the Dogon*, *Sacred Symbols of the Dogon,* and *The Cosmological Origins of Myth and Symbol*.) Our knowledge of Dogon society comes primarily from a thirty-year-long study that was conducted by French anthropologists Marcel Griaule and Germaine Dieterlen, which ended in 1956. The results of this study were documented in Griaule and Dieterlen's final report on the Dogon religion, called *The Pale Fox.* Since the time of that study it has become apparent that the Dogon cosmology reported by Griaule and Dieterlen also presents a very close match for ancient Buddhist cosmology.

The Dogon are known to observe five different calendars:

1. The Dogon **lunar calendar** (which, like the ancient Buddhist calendar) consists of twelve 29- to 30-day months, for a total of 354 days, with one intercalated day to make 355. This comes up short against a 365-day year by 10 days per year, or 30 days every three years, at which time a "leap" month is added.
2. The Dogon **luni-solar calendar,** which consists of twelve 30-day months, totaling 360 days, with no intercalation. Because according to Griaule and Dieterlen, agriculture regulates the calendar, the year begins at the millet harvest and needs no intercalation; it simply restarts at the next harvest.
3. The Dogon **solar calendar,** which consists of 365 days with a leap day added every four years.
4. The Dogon **Sirius calendar,** which begins at the heliacal rising of Sirius and defines a 365-day year.
5. The Dogon **Venus Calendar,** which measures the year in relation to movements of the planet Venus.[2]

While the Dogon do possess a 360-day calendar very much like that of ancient Egypt, there is no reference in Dogon culture to the five epagomenal days, days upon the year, or birthdays of gods. This again supports the notion that any presumed contact between the Dogon and ancient Egypt may have ended very early in Egyptian history, before the addition of the epagomenal days in Egypt.

If Velikovsky is right, then the suggestion is that there could have originally been two calendars in Egypt—the 355-day lunar calendar and the then-360-day solar calendar—which were reconciled to each other by the five intercalary days. After 757 BCE and the ostensible extension of the solar year, the 360-day calendar would have been reconciled to the new solar calendar by the five intercalary days. In both cases, the difference represents days "won from the moon" (a reference to the fact that the lunar calendar was shorter than the solar one) that are added to the lunar year in order to reconcile it with the solar year. Given the outward parallels between the Dogon calendars and those of ancient Egypt, the existence of a lunar calendar with 29- to 30-day months among the Dogon can be seen to support and clarify Egyptian textual references to 29-day months in Egypt.

As a way to uphold this viewpoint, we can cite remarks from Princeton University Professor Marshall Clagett's 1995 book *Ancient Egyptian Science, Volume II: Calendars, Clocks, and Astronomy.* Clagett writes, in regard to the opinions of Brown University scholar Richard Parker, "Parker turns to the listing of feast days in the Old Kingdom tombs to support his view that the first use of *wp rnpt* as a reference to the appearance of Sirius in the twelfth month was as a determiner of intercalation in the old lunar calendar. . . . I shall present the evidence which has led me to the conclusion that the year which was opened by Sothis's rising cannot have been the civil year or the fixed Sothic year . . . but must have been the natural lunar year."[3]

Meanwhile, traditional claims for the existence of ancient Egyptian and Chinese solar calendars of 365 days also do not seem to be supported by explicit statements that cite 365 as the number of days in a year, but rather only by questionable inferences made by later researchers based on their belief that a solar year must consist of 365 days. For example, while the Daming calendar of China is purported to have produced a year of 365.24281481 days,[4] none of the original calculations on which the calendar

was based have survived, and the calendar itself was not promoted until 504 CE by the inventor's son, long after Velikovsky's proposed change in the length of the year.[5] Consequently, Velikovsky's belief in the existence of an ancient 360-day solar year remains theoretically possible.

In the absence of explicit evidence for a 365-day year, either in Egypt or in some other ancient culture, we can at least say that there is a perspective from which Velikovsky's controversial proposition of an ancient 360-day year could make sense. If the ancient 360-day year, in fact, represented the true length of the solar year, then we would expect that many different ancient cultures shared the same year length (they did) and that we would be able to document a widespread changeover to a 365-day year around the middle of the eighth century BCE, as Velikovsky claims. Such documentation can be found in the many calendar revisions that are said to have occurred at, around, or just after 757 BCE. A modern-day reference for the history of calendars states:

> In the eighth century B.C.E., civilizations all over the world either discarded or modified their old 360 day calendars. The 360 day calendars had been in use for the greater part of a millennium. In many places, month lengths immediately after that change were not fixed, but were based instead upon observation of the sky. Priest-astronomers were assigned the duty of declaring when a new month began—it was usually said to have started at the first sighting of a new moon. Month length at that time was simply the number of days that passed from one new lunar crescent to the next. During those years in Rome, for example, a Pontifex (priest) observed the sky and announced a new moon and therefore the new month to the king. For centuries afterward Romans referred to the first day of each new month as *Kalendae* or *Kalends,* from their word *calare* (to announce solemnly, to call out). The word *calendar* derived from this custom. This practice of starting a month at the first sighting of a new moon was observed not only by Romans but by Celts and Germans in Europe and by Babylonians and Hebrews in the Lavant. All of these peoples began their month when a young crescent was first seen in the sky. This is still done for the Islamic Calendar, but a new moon's date is calculated for traditional lunar calendars that are currently used in China and India. During the period when month lengths were not fixed, new

> moons were usually sighted after either 29 or 30 days. If clouds obscured vision on the thirtieth day, a new month was declared to have begun. When month lengths were identical with lunations, only those that lasted 30 days were considered to be normal. This was probably because *all* months had previously been 30 days for such a long period of time.[6]

Wayne Horowitz of the Hebrew University offers us a view of calendars as they were observed in ancient Mesopotamia and Judaism from ancient times. There is no mention of intercalary days or an intercalary month in the Bible, and it is not known whether the correction to reconcile the lunar year to the solar year was applied in ancient times by the addition of one month in ten years or by the addition of ten or eleven days at the end of each year. Note again that the critical shift from a 360-day year to one of 365 days is understood to have happened according to Velikovsky's time frame:

> During the later portion of the Second Temple period in Israel, a 364 day calendar emerged to challenge the traditional lunar calendar with its regular year of 12 lunar months (approximately 354 days) and leap year of 13 lunar months (approximately 384 days). Evidence from cuneiform sources suggests that this ancient Israelite 364 day year, which appears in the apocryphal books of Enoch and Jubilees, and in the writings of the Qumran community, had its origins in a Mesopotamian ideal mean lunar year of 364 days (12 lunar months = 354 days plus 1/3 ideal lunar month [= 10 days]). This year length of 12 months plus 10 additional days is attested in Mesopotamia from the seventh century B.C.E. onwards, and itself represents an improvement on an ideal 360 day calendar year that dates back to the fourth millennium B.C.E.[7]

For those who may not realize how very prevalent the 360-day year had been in the earliest ancient times, the following is a quick and, admittedly, incomplete survey of ancient cultures that are known to have observed such a calendar, then later to have moved to a 365-day calendar:

Assyria
The Aztecs
Babylon

Carthaginia
Chaldea
China
Egypt
The Etruscans
The Greeks
The Hebrews
The Hindus
The Incas
The Maya
The Olmec
The Persians
The Phoenicians
The Romans
The Teutons
The Tibetans

As we consider these global calendar changes, let’s presume for a moment that Velikovsky’s scenario is wrong. We might entertain the viewpoint of the traditional Egyptologists and postulate that the year had always been 365 days long and that the 360-day year and 30-day month had never been anything but ceremonial in nature. In that case, we can only ask what known global cultural influence during the mid-eighth century BCE could have induced so many widespread cultures to abandon their ceremonial year in favor of a 365-day year at the very same moment in time? Or we could take the position that the seemingly universal 360-day year of the ancient world reflected the actual length of the physical year at the time it was adopted.

Given that we know with certainty that many of these cultures had long been careful observers of astronomy, capable of engineering large structures in stone in such a way that a specific star might rise above a stone marker on a given day or the sunrise might highlight the interior of a chamber or cast a shadow on a stairway in some symbolic way on precisely the same day of every year, how are we to explain this seemingly globally synchronous

impulse to make the self-same change in the reckoning of the year—each culture adding five days to a previously longstanding 360-day year and/or moving from a 30-day month to a new way of reckoning months—except as the consequence of some actual physical global effect? Can we seriously believe that after millennia of observation, the astronomers of these cultures suddenly all noticed at the very same moment that their 360-day year was five days too short? An uncorrected ancient 360-day calendar would have erroneously predicted summer to occur during the middle of winter after only thirty-six years! Surely some bright astronomer-priest—or perhaps some farmer whose livelihood depended on the accuracy of a calendar—would have noticed!

Imagine that, from a distance, you are watching a crowd of people walking down a busy street in New York City. Suddenly, without warning, they all duck to the left at the same moment. You don't have to actually see the object that caused them all to duck in order to conclude with assurance that the people in the crowd must have perceived that there was an object. That is very much what seems to be the case with calendars in 757 BCE; their near-simultaneous revision would seem to be a reaction to a single, common, tangible impulse.

It seems apparent that the global transition to a 365-day calendar can only imply one of two things: that an unknown, global, synchronized cultural influence somehow induced many different cultures to abandon their ritual calendars—commonly foreshortened to 360 days—all at the very same moment, or else that some remarkable cosmic event somehow actually changed the physical length of a day, year, or month. With no historic evidence of any known cultural force that could have catalyzed this kind of worldwide calendar change, let us ask ourselves what other theoretic event or influence could possibly have occurred that would be capable of producing these effects *except* the close approach of an astronomic body to Earth? It seems clear that the calendar changes that are documented to have occurred in or around 757 BCE justify us entertaining at least this one tenet of Velikovsky's very unlikely scenario—that something during that historical period may have physically disrupted the longstanding motions of Earth and the moon.

Another likely global effect of Velikovsky's scenario that should be

detectable would be significant changes in climate that may have occurred during the middle of the eighth century BCE as a consequence of a cosmic encounter. Theoretically, these could have been caused by a change in the tilt of Earth's axis, as Velikovsky surmises (but traditional scientists dispute), and/or the lengthening of Earth's orbit around the sun. As it turns out, reports of climate changes are quite common in various types of studies of this period. One report from Princeton and Stanford universities on changes in climate in Europe states, "Between 850 and 750 BC there was a broad shift from a hot, dry sub-Boreal climate regime to a cool, wet sub-Atlantic system. According to one paleoclimatologist, 'If such a disruption of the climate system were to occur today, the social, economic, and political consequences would be nothing short of catastrophic. . . .' Palynology reveals countless local variations, but the general outcome was disastrous for temperate Europe."[8]

Another similar report, this time based on archaeological evidence, specifically assigns likely blame for climate change in Siberia to a presumed decline in solar activity. It states, "In south-central Siberia archaeological evidence suggests an acceleration of cultural development and an increase in the density of nomadic populations around 850 BC. We hypothesize a relationship with an abrupt climatic shift towards increased humidity caused by a decline of solar activity."[9]

J. Derral Mulholland—one of the scientists previously quoted, who presented in opposition to Velikovsky at the 1974 AAAS symposium—stated that a 1 or 2 percent change in Earth's year could be thinkable, but that a drop from a 365-day year to one of 300 days would increase solar heating by 20 percent and probably be fatal to most life-forms on the planet.[10] Based on his perspective, if a shorter year would produce increased solar heating, then an increase in the number of days in the year such as Velikovsky proposes, from 360 to 365 days, should have produced a corresponding reduction in solar heating and so caused a noticeable global cooling trend, sometime just after 750 BCE. Historians note that the "Egyptians document an unnamed cooling trend about 750 to 450 BC—just before the founding of Rome."[11]

Just as we have seen in regard to other evidence that is pertinent to resolving the Velikovsky controversy, it seems that efforts to establish absolute dates for events and artifacts from the period around the eighth

century BCE are hampered by a highly unusual circumstance. Jean MacIntosh Turfa of the University of Pennsylvania Museum writes, in review of a study by Gilda Bartoloni and Filippo Delpino:

> Although we have outgrown the equation pots = people, we still need to reconcile archaeological discoveries with the available historical information about the pre- and proto-historic cultures of Italy. The endeavor is complicated by tantalizing, quantifiable evidence from radiocarbon and tree-ring analyses: they yield eerily precise absolute dates that do not always match our theories. To complicate matters, it has been shown that radiocarbon dating is affected by a change in the amounts of isotopes taken in by plants and animals during the crucial early centuries of the first millennium BC, and thus dates given in older literature are no longer reliable. Further, soil conditions in most Italian sites have not preserved the wood samples needed to calibrate dates by tree-ring comparisons, as has been possible for transalpine Europe. Analytical studies have shown that the radiocarbon decline in the atmosphere occurred ca. 850–760 BC, and abrupt, global climate changes ensued around 800 BC, rendering many European sites unsustainable due to cold, wet weather. There is growing evidence of similar travails, both climatic and social, in early Italy.[12]

Yet another study—this time of the radiocarbon content in tree rings—that focused on the same eighth-century BCE time period also reports significant fluctuations in radiocarbon levels that could be consonant with Velikovsky's scenario. It states, "Fluctuations in the atmospheric radiocarbon level observed by measurements of the radiocarbon content of tree-ring-dated-wood are caused by changes in the geomagnetic field and in the activity of the sun. There are also indications for correlations of these carbon-14 fluctuations with climatic changes. If one assumes that the observed correlations are significant, then one might suspect that major climatic changes have occurred during the eighth century B.C."[13]

As we suggested during our discussion of whether Venus could have made a close approach to Earth, any such astronomic event should have been accompanied by significant geological upheaval. Referring again to the list of major volcanic eruptions compiled by the Global Volcanism Program of the

Smithsonian, we can again show that the era of 750 BCE was visited by a large number of major volcanic eruptions, which are also again reported to have happened in many different regions of the world.[14]

MAJOR VOLCANIC ERUPTIONS, 950–550 BCE

VOLCANO	VOLCANIC SUBREGION	CODE	DATE (REVERSE ORDER)	VEI (VOLCANIC EXPLOSIVE INDEX)
Tongariro	New Zealand	C	550 BCE ± 200 years	5
Pelee	West Indies	G	590 BCE ± 200 years	4 (?)
Aoga-Shima	Izu Islands (Japan)	C	600 BCE ± 200 years	4
Krafla	Northeastern Iceland	T	650 BCE (?)	4
Ibusuki Volcanic Field	Kyushu (Japan)	T	650 BCE (?)	4
Pululagua	Ecuador	C	690 BCE ± 150 years	5
Bravo, Cerro	Colombia	C	730 BCE ± 75 years	4+
Towada	Honshu (Japan)	G***	750 BCE (?)	4+

Concepcion	Nicaragua	C	770 BCE ± 50 years	P
Shiveluch	Kamchatka peninsula (Russia)	G	780 BCE ± 300 years	4+
Momotombo	Nicaragua	C	800 BCE ± 50 years	4+
Yantarni	Alaska peninsula	T	800 BCE ± 500 years	5
Tengger Caldera	Java (Indonesia)	C	830 BCE ± 50 years	P
Zavaritsky	Kamchatka peninsula (Russia)	C	850 BCE (?)	4+
Ruiz, Nevado del	Colombia	T	850 BCE (?)	4
Katla	Southern Iceland	G	850 BCE ± 50 years	4
Vesuvius	Italy	G	880 BCE ± 50 years	4
Sollipulli	Central Chile	C	920 BCE ± 75 years	5+
Khodutka	Kamchatka peninsula (Russia)	G	930 BCE ± 100 years	5
Fuji	Honshu (Japan)	C	930 BCE (in or after)	5
Azufral	Colombia	C	930 BCE (?)	P
Shiveluch	Kamchatka peninsula (Russia)	G	950 BCE (?)	5
Miyake-Jima	Izu Islands (Japan)	T	950 BCE ± 200 years	4

Codes:
C = carbon-14 (uncorrected)
G = carbon-14 (corrected)
I = ice core
P = Plinian eruption, VEI uncertain
T = tephrochronology

The magnetic fields of the planets play a large role in Velikovsky's theoretic scenario of the cosmic interactions of Earth, the moon, Venus, and Mars. According to Velikovsky's scenario, Venus made its approach to Earth around 1500 BCE, after which Mars is said to have made recurring near passes of Earth, the most significant of which is said to have happened around 750 BCE. Just as the eruption of Thera on the island of Santorini is associated by traditional historians with the end of the Minoan Empire, Velikovsky also associates these planetary interludes with the major transitions of ancient Egypt.

However, just as the magnetic fields of Venus or Mars may have left a residual impact on the rocks of the moon and on lava flows on Earth, so these interactions may also have had a measurable impact on the magnetic field of Earth itself. In the context of a discussion of his correct prognostication, Velikovsky is quoted in *The Velikovsky Affair* as stating, "H. E. Suess, because of an accumulation of certain discrepancies in the radiocarbon dates, assumes that natural events caused a radical change in the intensity of the magnetosphere and in the influx of cosmic rays sometime in the second millennium before the present era. Several other researchers came to the same conclusion. This is also in harmony with the story related in my book."[15]

Although the underlying causes for changes in the intensity of the magnetic field of Earth are still poorly understood, studies have been done to identify the historical points at which the most significant changes in the intensity of the magnetic field are thought to have occurred. One such study, titled "Possible Impact of the Earth's Magnetic Field on the History of Ancient Civilizations," states:

> The history of cultural changes in Egypt and in Mesopotamia has been the subject of many textbooks. In this study, we only focus on well-accepted changes, such as the transition between the Old and Middle Kingdoms, the transition between the Middle and New Kingdoms and the end of the New Kingdom in Egypt. These successive transitions were marked by three "intermediate" periods dated at ~2150–2000 BC, ~1800–1550 BC and ~1100–650 BC respectively.
>
> Altogether these data show several interesting features, particularly the occurrence of strong geomagnetic field intensity variations. The two older ones . . . are dated at ~2800–2600 BC and ~2100–1900 BC. . . . The new result from Terqa provides evidence for yet another occurrence between ~1750 and 1500 BC. The period of ~1000 years between the fall of Mari (~1750 BC) and the beginning of the first millennium BC, up to ~750 BC, is characterized by an increase in geomagnetic field intensity by a factor of two [1–3] . . . with first a strong increase between ~1750 and 1500 BC, then a moderate increase between ~1500 and 1200–1100 BC and finally another strong increase up to ~750 BC. In contrast, the two results from Susa indicate a strong intensity decrease between ~700

> and 200 BC. Data . . . therefore point toward four potential geomagnetic events . . . during the last three millennia BC.[16]

Another recent article discusses the phenomenon of geomagnetic reversal and the effects it can have on our planet. The article, titled “Geomagnetic Reversal and Its Effects,” states, “The pattern in magnetic reversal is not periodic, showing reversals that can occur in short periods of 100 thousand years apart to periods that are millions of years between them. This stochastic process suggests that some agency has triggered a flip or reorientation of the geomagnetosphere on a regular, if not uniform basis.”[17]

In other words, the traditionally accepted scientific records of major fluctuations in the magnetic field of Earth—fluctuations of uncertain cause, in the traditional view—report unexplained major geomagnetic events for which scientists seek a postulated catalyzing agent. These events coincide historically both with Velikovsky’s claims for the close approach of Venus and Mars to Earth and with the same major transitions in ancient Egyptian culture that Velikovsky attributes to these encounters.

Velikovsky’s claim that the close approach of Mars in 757 BCE initiated a change in the tilt of the axis of Earth—so that, following the encounter, it may have taken centuries to ultimately settle into its present 23.5-degree angle—is supported by ancient records of eclipses that were preserved in China. Although Chinese astronomic observations—passed down from texts transcribed beginning around 200 BCE—are generally considered to be reliable, modern-day calculations have been unable to confirm the dates of many solar eclipses recorded prior to 757 BCE. Independent researcher and mathematical analyst Douglas J. Keenan writes the following in his 2002 article “Astro-Historiographic Chronologies of Early China Are Unfounded.”

> The *Bamboo Annals* (Zhushu jinian) is perhaps the ancient text most often used for chronology. It explicitly records one solar eclipse after 841 BC; that eclipse, in 776 BC, did not occur. The *Spring and Autumn Annals* (Chunqiu) is an ancient text with records of many solar eclipses (both total and partial). It records solar eclipses on 3 April 645 BC, 15 May 592 BC, 19 September 552 BC, and 18 July 549 BC; yet there were no eclipses on those dates. This text also records many other solar eclipses that did occur. Thus, although the text seems to be a valuable

> historical document, no single record from it should be assumed to be accurate.
>
> The sole *Bamboo Annals* astronomical record from after 841 BC—the eclipse of 776 BC—is almost certainly a forgery. The most difficult part of eclipse calculations is to find the locations on Earth where the eclipse was observable. Determining that there was an eclipse—somewhere on Earth—is easier. Thus, we would expect a period in Chinese history when astronomical knowledge was sufficient to calculate that an eclipse occurred at some particular time, but insufficient to correctly calculate the eclipse's location. There was an eclipse in 776 BC on the most-likely date indicated by the record (6 September), but it was not observable in ancient China. (It reached near totality around the Barents Sea—in the Arctic.) That an actual eclipse would match the record's date just by chance is very improbable.[18]

Keenan goes on to imply that it is generally understood by scientists that astronomic records made prior to the eighth century BCE cannot be relied on to be accurate, although, since the ancient astronomic observers of many cultures are widely considered to have been quite capable, it is difficult to understand why this might be, or if so, why only prior to the eighth century BCE. Continuing from the same source, he writes, without specific elaboration, "Astronomical records from before 841 BC are naturally expected to be even less reliable, in general, than those from after 841 BC. Causes of unreliability are many."

To explain these problems, traditional researchers assume either that the Chinese texts must be inherently unreliable or that their entries must have been fraudulent. However, it is not difficult for the nontechnical reader to understand that, had a close approach of Mars actually changed the tilt of Earth's axis—even slightly—in 757 BCE, as Velikovsky claims, such an event would effectively thwart any modern effort to retrospectively calculate the timing and location of cyclical astronomic events such as eclipses prior to that date.

11

WHAT EVIDENCE IS THERE THAT VENUS WAS OUT OF ITS ORBIT?

If Venus did begin its life as a comet, as Velikovsky proposes—one that may have roamed the solar system for centuries before being transformed into a proper planet after its fateful encounters with Mars and Earth—then his scenario also implies that the motions of Venus during the early centuries CE must necessarily have been quite different from the familiar motions of Venus as we now know them. Again, in our efforts to either affirm or deny Velikovsky's views, it makes sense to rely on modern sources to which Velikovsky had no access and whose authors have no apparent allegiance to Velikovsky's thesis.

Perhaps a good place to begin this discussion is again with the *Bamboo Annals* from the Zhou period in China, which, as we mentioned in chapter 10, preserve records of ancient observations of solar eclipses and periodic conjunctions of the five planets. However, modern mathematical regressions have had difficulty confirming many of these sightings. Douglas J. Keenan again writes:

> There are five planets that are visible with the naked eye. When two or more of these planets appear to be close to each other, they are said to be *in conjunction.* It is unclear how close planets would had to have been in order for the ancient Chinese to have considered them to be in conjunction. . . . There are seven historical texts from after the Han period (ended AD 220) that record five-planet conjunctions. . . . The main such proposals rest on a trio of five-planet conjunctions, in 1953 BC, 1576 BC, and 1059 BC. There was [based on mathematical calculations], however, no five-planet conjunction in 1576 BC, only a four-planet conjunction: at the time of the "conjunction," Venus was over 40 degrees away from the other four planets . . . attempts to promote the proposals have essentially ignored this.[1]

The apparent contradiction between the ancient sighting in 1576 BCE and modern regressions supports the notion that Venus was not—at that time—located where we expect it to have been. In further support of Velikovsky's belief that unusual things were happening to Venus, it seems that ancient Babylonian records, recorded by astronomers from the early centuries BCE, present difficulties for modern-day scholars who try to reconcile their data regarding the movements of Venus with modern values.

> By the Seleucid period (ca 301–164 BC), we have a number of late goal-year texts in which the eight-year period was used to predict the appearances of Venus. These goal-year texts are clay tablets that list astronomical data for a given year and also for years specified by adding an appropriate number to the starting year. For Venus, the number to be added is eight. Accordingly, the pattern in the table for Venus will work for every eighth year from the year for which the table is prepared. For example, Professor Otto Neugebauer, one of the foremost historians of ancient science, described one of the Venus goal-year texts and showed that it provides dates and positions for Venus at last visibility as a morning star in steps of eight years. Another lists the planet's reappearance as an evening star over three eight-year intervals. Although the eight-year, five-cycle Venus period is close, it is not exact. After eight years, Venus is actually a little ahead of schedule, about 2.4 days.[2]

In the first century CE, Greek mathematician, astronomer, geographer, and astrologer Ptolemy made detailed observations of the risings and settings of Venus that are at odds with our current experience. In support of Velikovsky's view, a 2002 article by Hugh Thurston titled "Unveiling Venus" seeks to resolve the seemingly untenable differences between Ptolemy's observations of the motions of Venus and those known to be true today. He writes, "Several writers have suggested that Ptolemy adjusted (or even fabricated) his observations [of Venus]. In particular, Swerdlow wrote that Ptolemy 'could not have observed some of the reported elongations' (he certainly could not have observed two MMEs [maximum mean elongations] 37 days apart)."[3]

Dennis W. Duke, a professor of physics at Florida State University, writes in a 2002 article titled "The Ancient Values of the Planetary Parameters of

Venus and Mercury," "It is certainly the case that for Venus, and only for Venus, Ptolemy presents an analysis that . . . needs to be resolved."[4]

As late as the early 1500s, significant differences are noted in the astronomic observations of Venus, even when given by well-respected astronomic luminaries of the day. For example, it is reported that Copernicus, who famously established the heliocentric model of the solar system, calculated the sidereal period of Venus to be nine months (270 days) instead of seven and one-half months (225 days). Such errors, which are often seen by modern astronomers to be inexplicable, might make sense if Velikovsky's view that Venus was out of its orbit were true.[5]

As we might also expect based on Velikovsky's scenario in which the orbit of Venus may have been in flux, there are also significant contradictions to be found between Ptolemy's observations of Venus in the first century CE and those of Copernicus fourteen centuries later. Venus, as a planet that reflects the light of the sun that is shone on it, moves through apparent phases when viewed from Earth, similar to the familiar phases of the moon. Such phases could appear significantly different to us for different bodies, depending on the specific relationship of that body in space to Earth and the sun. Both Ptolemy and Copernicus produced drawings that purported to diagram or predict the various phases of Venus. However, Lewis A. Riley, a professor in the Department of Physics and Astronomy at Ursinus College, wrote in 2004:

> The phase of a planet or moon depends on its position relative both to the Sun and the observer. Hence, any model of the solar system can be used to make predictions regarding the phases of the planets and moons. From our perspective on Earth, Mercury and Venus are *inner planets*. That is, they are closer to the Sun than we are. The Ptolemaic and Copernican models of the solar system make different and incompatible predictions regarding the phases of the inner planets viewed from Earth. Hence, observations of the phases of the inner planets lead us to reject one or both of these models.[6]

One longstanding complaint againt Velikovsky's theory (raised by Carl Sagan and Cecilia Payne-Gaposchkin of Harvard University and by John Q. Stewart of Princeton University) involves a perceived degree of

“marksmanship” required of the comet Venus in order for it to have had such a disruptive effect on both Earth and Mars. Velikovsky responded to this complaint in *Velikovsky and Establishment Science,* where he stated, “The image of ‘marksmanship’ is not well derived. . . . If a comet with a tail 100 million miles long should move in the ecliptic, no good fortune would keep the planets from passing through its fabric; at its every passage inside the terrestrial orbit, the Earth would have a better than 60 to 40 chance of going through its tail or head.”[7]

In regard to the likelihood of Earth passing through the tail of a comet, astronomer Courtney Seligman writes:

> For those comets whose perihelion distance is less than the size of our orbit, it is not unusual for us to approach some point in their orbit, at some point in our orbit around the Sun. And given the broad swath of material lost by the comet each time it goes round the Sun, it would hardly be surprising if some of the material lost by the comet might pass even closer to our orbit than the comet, and that it might even run into our atmosphere, causing a streak of light in the sky, called a *meteor*. And in fact, over 90% of meteor trails are caused by debris lost by comets in the last few decades or centuries, which is still following more or less the same path as the comet which lost the material.[8]

12

COULD VENUS BE A YOUNG PLANET?

After the death of Immanuel Velikovsky and before the turn of the century, a number of different space missions—including the Venera, Vega, Magellan, Galileo, and Cassini probes—were all sent to explore various aspects of the planet Venus. Likewise, in November 2005, the European Space Agency launched the Venus Express probe—postured as a kind of companion mission to an earlier Mars Express probe—which reached Venus in April 2006 and began to return a wealth of new, quality data relating to the planet Venus. These missions have provided us with much new information about Venus that was not available in Velkovsky's lifetime, which can potentially be used to evaluate various aspects of his thesis.

As we have suggested, if we were to disregard all other aspects of *Worlds in Collision*, the whole of Velikovsky's theory might be seen to turn on only a few pivotal questions. The answer to one of these questions—whether Venus could be a young planet—rests on our eventual ability to establish a definitive age for the planet Venus based on some indisputable fact. Clearly, if we were to pinpoint even a single fact that could show beyond question that Venus must be at least a million years old, then the whole of Velikovsky's remaining theory would simply evaporate. Likewise, if we were able to demonstrate with reasonable certainty that Venus must be significantly younger than a million years old, it would establish a credible rationale for the careful reconsideration of Velikovsky's theories.

Early probes to Venus offered us our first window on the likely age of Venus. Outwardly, their data supported Velikovsky's controversial prediction that Venus would be found to be very hot—a fact that Velikovsky said was critical to proving his thesis that Venus was a young planet. However, at the time of the discovery, rather than crediting the fact as a point in favor of Velkovsky's prognostications, astronomers of the day, led by Carl Sagan, simply proposed an alternate theory to explain the high temperature of Venus. They postulated that the high concentration of carbon dioxide in the

Venusian atmosphere had created a “runaway greenhouse effect” that served to foster and sustain the unexpectedly high temperature. In his book *Broca’s Brain,* Sagan cited a list of reasons for not crediting Velikovsky with his claim that Venus would be hot. Sagan wrote:

(1) the temperature in question was never specified [by Velikovsky];

(2) the mechanism proposed for providing this temperature is grossly inadequate;

(3) the surface of the planet does not cool off with time as advertised; and

(4) the idea of a high surface temperature on Venus was published in the dominant astronomical journal of its time and with an essentially correct argument ten years before the publication of *Worlds in Collision*.[1]

Some researchers actually cite the current temperature of Venus as a point *against* Velikovsky, claiming that any astronomic body the size of Venus that was ostensibly incandescent only a few thousand years ago should still be molten (notwithstanding the fact that one common definition of the word *molten* relates to an ability to melt lead, which the surface temperature of Venus is often said to be sufficient to do). In truth, no one can say at precisely what temperature Venus may have been when it theoretically was ejected from Jupiter, which is thought to range from some 23,871 degrees Celsius (43,000 degrees Fahrenheit) at its core to -145 degrees Celsius (-230 degrees Fahrenheit) at the top of its clouds.[2] Likewise, no one knows for certain how quickly such material might have cooled after its ejection from Jupiter, how its temperature might have been affected during its theorized travels as a comet, or how much it may have been heated again during close approaches to the sun or its proposed interactions with Mars or Earth. Given all of these unfactorable variables, it seems safe to say that any precise determination of a current temperature for Venus would be effectively unquantifiable and that Velikovsky’s statement that the planet would be found to be unexpectedly hot (as it was ultimately found to be) may have been appropriately vague to the circumstance.

Once space probes were able to actually examine the surface features of Venus, the question of the age of the planet again became a point of discussion. One method that astronomers often use to estimate the likely age

of an astronomic body is to count the number of impact craters that are found on the surface of the body. Since impact craters typically accumulate over time, a larger number of craters can be taken to indicate a higher age for the body in question. In his 1974 presentation to the AAAS symposium in San Francisco, Sagan cited the number of craters then believed to exist on Venus as one of ten major points against Velikovsky's theory. He said that the Jet Propulsion Laboratory had found "from radar which penetrates Venus's clouds and is reflected off its surface, that the planet is cratered, and, perhaps, like parts of the moon, is saturation-cratered. . . . If Venus was, thirty-five hundred years ago, in the deep interior of Jupiter, there is no way it could have accumulated such impacts there. The clear conclusion from the craters of Venus is, therefore, that Venus has been for billions of years an object exposed to interplanetary collisions—in direct contradiction to the fundamental premise of Velikovsky's hypothesis."[3]

Upon direct observation, however, Venus was found to have a surprisingly low number of impact craters, along with a relatively pristine surface, just as Velikovsky surmised. If, in Sagan's words, the lack of a pristine surface could be counted among ten major points against Velikovsky and was said to categorically disprove his theory, then it would seem that the reverse should also be true—that the later confirmation of a pristine surface on Venus ought to be counted in some large way in favor of Velikovsky's view. However, again, traditional astronomers argued—this time in direct contradiction of Sagan's statement—that the lack of craters on Venus did not reflect youthfulness in the planet; instead they proposed that a pristine surface must imply that the planet had been somehow globally resurfaced. As a mechanism by which this global resurfacing could have occurred they simply proposed "unknown geological forces," again estimated to have occurred sometime within the past 500 million years.

Another referent to the likely age of Venus can be found in its internal temperature. Based on comparisons with other smaller rocky planets in the interior of the solar system like Earth and Mars, which have both cooled substantially since their formation, we might think that the older a planet is, the greater the likelihood that its interior would have also have cooled. This means that the discovery of a hot, active interior on Venus would be more outwardly supportive of Velikovsky's thesis, while a cooler, inactive interior

would support the traditional scientific viewpoint. In the 1990s, many astronomers believed, based on comparisons to Earth and Mars, that major volcanic activity would be found to have largely ended on Venus some 500 to 800 million years ago. However, those beliefs are contradicted by a study conducted by Walter Kiefer, a doctor of planetary science and geophysics at the California Institute of Technology. He writes in a 1997 article titled "How Thick Is the Lithosphere on Venus?" part of a webpage titled "Venus Geophysics Research":

> The lithosphere of a planet is the strong, outermost portion of the planet. The thickness of this layer depends on the temperature inside the planet. Planets with hot, active interiors will have thin lithospheres. Planets with cold, inactive interiors will have thick lithospheres. By studying the gravity over features such as large volcanos, it is possible to place constraints on the thickness of the lithosphere of a planet. Thus, in an indirect way, the gravity measurements can tell us about the temperature structure of a planet.
>
> I have used these ideas in a study of eight large shield volcanos on Venus. The results of this study indicate that the elastic lithosphere in these regions of Venus ranges between 10 and 20 kilometers thick [as compared with lithospheres of 50 to 100 kilometers thick on Earth and Mars]. These results indicate that Venus has a hot, active interior.[4]

In regard to the question of establishing a definitive age for Venus, an apparent blow to Velikovsky's thesis came in 2009 with the announced discovery of granite on the surface of Venus. Basalt, a lighter substance that is known to compose much of the crust of Venus, is a rock that forms quickly as lava cools. Granite, however, typically appears in the context of crustal plates, both of which can require millions of years for their formation. Consequently, any confirmed discovery of either crustal plates or granite on Venus would directly contradict Velikovsky's claim for the youthfulness of Venus. The article that included the announcement states:

> A new look at data gathered from the Galileo spacecraft in 1990 reveals that Venus at one time may have been habitable, with evidence of past continents and oceans. In a flyby of Venus on the spacecraft's journey to

> Jupiter, a near-infrared mapping instrument detected signatures which the researchers have interpreted as granite. An international team led by planetary scientist George Hashimoto, at Okayama University, Japan, found that Venus's highland regions emitted less infrared radiation than its lowlands. One interpretation of this dichotomy, says the team's new paper, is that the highlands are composed largely of "felsic" rocks, particularly granite. Granite, which on Earth is found in continental crust, requires water for its formation. The Galileo spacecraft was the first use of infrared to look at Venus. Scientists had believed that only radar could see through the dense clouds of sulfuric acid in Venus's atmosphere to the surface. "Detecting the surface in the infrared is a breakthrough," co-author Kevin Baines from JPL was quoted in an article in *Nature*.[5]

However, the same announcement was qualified by an important disclaimer, which stated, "The article also quoted another JPL scientist, David Crisp, who was not involved in this study as saying these new conclusions aren't supported either by the available data or the team's own models."

A similar report on July 14, 2009, this time based on results from the Venus Express probe, also purported to have found evidence of continental plates on Venus. However, this report again came with an attached disclaimer and so still fell short of an unqualified announcement of the discovery of granite on Venus.

> Venus Express has charted the first map of Venus' southern hemisphere at infrared wavelengths. The new map hints that our neighbouring world may once have been more Earth-like, with a plate tectonics system and an ocean of water.
>
> The map comprises over a thousand individual images, recorded between May 2006 and December 2007. Because Venus is covered in clouds, normal cameras cannot see the surface, but Venus Express used a particular infrared wavelength that can see through them.
>
> Although radar systems have been used in the past to provide high-resolution maps of Venus' surface, Venus Express is the first orbiting spacecraft to produce a map that hints at the chemical composition of the rocks. The new data are consistent with suspicions that the highland

plateaus of Venus are ancient continents, once surrounded by ocean and produced by past volcanic activity.

"This is not proof, but it is consistent. All we can really say at the moment is that the plateau rocks look different from elsewhere," says Nils Müller at the Joint Planetary Interior Physics Research Group of the University Münster and DLR Berlin, who headed the mapping efforts.[6]

The nature of the crust of Venus offers additional evidence that could potentially have bearing on Velikovsky's thesis. In general, it is thought that planets that cooled quickly at their time of formation have thicker crusts, while those that cooled more slowly have thinner crusts. On Earth, continental plates are thought to have formed during the first few million years. Along with this early plate activity came the formation of granite rock. A September 2010 article by the European Space Agency called "Venusian Geography" relates the most current scientific thinking about the crust of Venus. The article states, "On Venus there does not seem to be any tectonic plate activity to move and shape the surface. On the contrary, it seems that there is a single plate covering the whole planet. Whether this crust is thick or thin, and whether it still moves, no one yet knows."[7]

Venus is also known to have a slowly rotating core. While some recent evidence suggests that the core of Venus is entirely liquid, some astronomers support the longtime belief that, like Earth, Venus must have a solid core inside a liquid core. On Earth, the solid core is thought to have grown over time, as heavy metals sink to the center of the planet. From this perspective, the lack of a solid core on Venus might be interpreted as another possible indicator of its young age, as surmised by Velikovsky.

Alongside this same issue lie questions that relate to Venus's magnetic field. Venus has been shown to have virtually no magnetic field. According to the European Space Agency, this may be due to the slowness of its rotation or may also possibly be a product of other factors. Theoretically, one of these factors could be age; a young Venus may not have had sufficient time yet to develop the kind of solid core required to produce a magnetic field. Again, however, no definitive cause for the weakness of the magnetic field of Venus has yet been determined.

Some scientists do make direct comparisons between conditions as we find

them on Venus and those found early in the history of Earth, and so they uphold an impression that Venus could potentially be a young planet comparable to a more youthful version of Earth itself. Given that the environmental conditions that culminated in the Archean period on Earth are thought to have evolved over the first few million years, Velikovsky's contention that Venus is only several thousands of years old might seem to contradict these comparisons. However, we should remind ourselves that according to the traditional astronomic view, the planet Jupiter has been steadily cooling since the time of its formation billions of years ago. From this perspective, under Velikovsky's scenario, Venus would have been formed from material that had been substantially precooled from its earliest primordial state long before it was ejected from Jupiter. In the final summary of a 1990 NASA study of the surface magmas on Venus, authors P. C. Hess and J. W. Head state, "We conclude that magma and volcanic activity on Venus, in its broadest sense, could be very similar to that on Earth. . . . It is possible, therefore, that the present surface and volcanic processes on Venus may bear some resemblances to the pre-Archean on Earth, before nuclei of continental 'felsic' masses were firmly established."[8]

Other researchers have come to think that much more compelling parallels exist between Venus and a young Earth and have gone so far as to treat Venus as a kind of working model against which to compare early geological processes on Earth. Cursory research on the subject reveals that comparisons between the geology and atmosphere of Venus and that of the Archean era on Earth are quite commonplace. Dr. Richard Ghail, a research associate at the Imperial College in London, is quoted in a 2001 article from the SpaceDaily website:

> Venus is key to understanding what the early Earth was like during the late Archaean and early Proterozoic when precious resources were formed. While modern Venus is in a quiet state most of the time, is does enter into short periods of intense volcanic activity where the old surface of Venus is destroyed and a new one is created. In its early history when life evolved, Earth worked in a similar way to modern Venus. . . . I realized that there is a similarity between Venus and the early Earth because both situations involve buoyant lithosphere (unlike modern Earth, which is able to subduct its lithosphere). I will argue that, from the

> evidence from Venus, the early Earth did not have modern plate tectonics, but did have something that looked similar to it, which explains the confusing evidence from the geological record.[9]

In another 2001 article titled "Venus Holds Picture of Baby Earth," Ghail is even more direct in his comparisons between the two planets. In that article, he writes, "Scientists have found a time machine that will take them back 2.5 billion years. They call it the planet Venus. It turns out conditions on Venus today are analogous to Earth's earliest times in the Archaean and early Proterozoic eras."[10]

Another of Velikovsky's predictive claims for Venus, based on his presumption that it was a recently formed planet, was that it would be found to be cooling over time. Sagan, again in his 1974 presentation to the AAAS symposium in San Francisco, disputed this claim. He stated, "A repeated claim by Velikovsky is that Venus is cooling off with time . . . [however, based on surface cloud data available at the time] we see that there is not the faintest hint of a decline in temperature with time."[11]

However, a 2010 article by staff writers of the SpaceDaily web-site suggest that just the opposite may be true; they claim that models of Venus that were developed to determine whether the runaway greenhouse effect on Venus would eventually result in a red-hot Venus instead showed just the opposite. The authors of the climate model study concluded:

> The permanent heat—today we measure almost 470 degrees Celsius globally on Venus—might even have been much higher in the past and, in a runaway cycle, led to even more volcanism. But at a certain point this process turned on its head—the high temperatures caused a partial mobilization of the Venusian crust, leading to an efficient cooling of the mantle, and the volcanism strongly decreased. This resulted in lower surface temperatures, rather comparable to today's temperature on Venus, and the mobilization of the surface stopped. . . . However, the more greenhouse gases, the hotter the atmosphere—possibly leading to even more volcanism. To find out if this runaway process would end in a red-hot Venus, Lena Noack and Doris Breuer, co-author of the study, calculated for the first time a model where the hot atmosphere is "coupled" to a 3D model of the planet's interior. . . . "Interestingly, due

to the rising surface temperatures, the surface is mobilized and the insulating effect of the crust diminishes," says Noack. "The mantle of Venus loses much of its thermal energy to the outside. It's a little bit like lifting the lid on the mantle: the interior of Venus suddenly cools very efficiently and the rate of volcanism ceases. Our model shows that after that 'hot' era of volcanism, the slow-down of volcanism leads to a strong decrease of the temperatures in the atmosphere."[12]

13

COULD VENUS HAVE BEEN A COMET?

One area of interest that relates significantly to the controversies described in *Worlds in Collision* is Velikovsky's belief that Venus began its life as a comet. We have previously quoted several recently researched sources from ancient China, Korea, and Japan that appear to uphold the cometlike descriptions cited by Velikovsky. However, the seemingly corroborated testimony of these ancient sources might be more credible if it was accompanied by other recent scientific findings that could positively link evidence found on Venus to comets.

In May 2008, the European Space Agency announced the first-time discovery by the Venus Express probe of a rarely observed molecule called *hydroxyl* in the atmosphere of Venus. The announcement stated, "Venus Express has detected the molecule hydroxyl on another planet for the first time. This detection gives scientists an important new tool to unlock the workings of Venus's dense atmosphere. Hydroxyl, an important but difficult-to-detect molecule, is made up of a hydrogen and oxygen atom each. It has been found in the upper reaches of the Venusian atmosphere. . . . The reactive molecule has been seen around comets, but the method of production there is thought to be completely different from the way it forms in planetary atmospheres."[1]

The European Space Agency's announcement of the discovery of hydroxyls, which, despite the possible associations implied between Venus and comets, again did not mention Velikovsky by name, still seems to have navigated a wide berth around sensitive Velikovskian topics. We see this reflected in the apparent effort that was taken by the author to mention that differences exist in the way the molecule is thought to be produced on planets and in comets. Compare the very minimized wording of the agency's statement above that the hydroxyl molecule "has been seen around comets" with this much more emphatic description, given in a 2006 article, of the role played by the hydroxyl molecule in relation to comets: "The hydroxyl radical

OH is the most abundant cometary radical. It is detected in the coma at some distance from the comet nucleus, where it is assumed that water (H_2O) is broken down by solar UV radiation to form OH, H and O. It is chiefly the presence of this radical that leads to estimates of the amount of water ice sublimating from the comet nucleus. The comas of O and OH are far less extensive than the H coma but have comparable density."[2]

One of Velikovsky's more publicized expectations regarding the composition of the atmosphere of the comet Venus was that it would have consisted largely of hydrocarbons, having presumably acquired them from the atmosphere of Jupiter. Consequently, it was Velikovsky's expectation that the atmosphere of Venus would also be found to contain hydrocarbons. Although hydrocarbons have been shown to make up a measurable portion of the Jovian atmosphere, this expectation of Velikovsky's seems to have been overtly contradicted based on direct observation of Venus by earlier probes. The finding was announced—this time with loud, clear mention of Velikovsky's name—in 1969 in an article for the journal *Science* by William T. Plummer of the Department of Physics and Astronomy at the University of Massachusetts. He wrote, "Infrared reflection spectra of hydrocarbon clouds and frosts now give a critical test of Velikovsky's prediction that Venus is surrounded by a dense envelope of hydrocarbon clouds and dusts. Venus does not exhibit an absorption feature near 2.4 microns, although such a feature is prominent in every hydrocarbon spectrum observed."[3]

However, using later data returned by the Venus Express probe, the author of a 2010 article in *Science News Review* offers a potential explanation for the seeming contradiction with Velikovsky's thesis:

> Some readers may recall the infamous Velikovsky Affair, the concerted scientific persecution of Immanuel Velikovsky due to his 1950 theory that Venus was ejected from the planet Jupiter just about 3,500 years ago (possibly the result of cometary impact, something we observed just a few years ago). Velikovsky made a number of predictions about the high temperature (primarily internal heat), the circular orbit, and the atmosphere of Venus. He predicted a high concentration of petroleum hydrocarbons in gaseous form circulating in the atmosphere, but planetary scientists have not found the large molecules he predicted. One

of the most exciting findings from the *Venus Express* mission was the discovery of Earth-like Lightning on Venus, which now places Venus in the exclusive company of Earth, Jupiter and Saturn as the only planetary bodies in our solar system known to generate lightning. According to one NASA-sponsored scientist on the mission. . . .

Lightning on Venus—as well as on any other planet—is an important discovery because the electrical discharges drive the chemistry of an atmosphere by breaking molecules into fragments that can then join with other fragments in unexpected ways. The lightning on Venus is unique from that found on Earth, Jupiter and Saturn in that it is the only lightning known that is not associated with water clouds. Instead, on Venus, the lightning is associated with clouds of sulfuric acid.

The sulfur clouds (sulfur dioxide and sulfuric acid) are above the CO_2 and water vapor canopy layer, higher in the stratosphere, which is where the strong lightning was observed. Which, if there are hydrocarbons in the Venusian stratosphere—as there are in Jupiter's—may explain why large molecules aren't found. They've been "cracked" by strong electrical discharges.[4]

If, as Velikovsky claims, Venus did begin its life as a comet, then we might expect to find some tangible remnant effects on Venus that can be associated with its mythical cometary tail. In 1990, Larry H. Brace of NASA's Goddard Space Flight Center in Greenbelt, Maryland, discovered unexplained variances in the number of electrons found by a Pioneer probe in the atmosphere of Venus as it made its observations of the planet on successive orbits. The solution to these changing counts was found in an unexpected dynamic process that seems to occur on Venus:

The density of the solar wind appears to influence the up-and-down electron population measured by Pioneer Venus to a far greater extent than does the sun's EUV. Sometimes, the authors suggest, the solar wind just transports the electrons around to the planet's night side. But on other occasions, when the solar wind contains a greater number of charged particles, it may "blow" the electrons completely past the ionosphere and into space. Most of the difference in the number of Venus ionospheric electrons shows up in the "ionotail," a term Brace coined in 1987 to describe the portion of the ionosphere that the solar wind pushes out into

space so that it resembles the tail of a comet.[5]

A diagram given in the May 31, 1997, issue of *New Scientist Magazine* depicted this tail of Venus and reported an unexpected discovery made by the European Solar and Heliospheric Observatory satellite—that this remnant tail actually extends millions of miles into space, points away from the sun just like a comet's tail, and reaches as far as Earth at the point of the nearest approach between the orbits of Venus and Earth. This is the same point of resonance at which Venus turns a constant face to Earth.[6]

In regard to the method of production of this ostensible "remnant cometary tail" of Venus, studies suggest that the tails of comets are the product of an effect called the Kelvin-Helmholtz Instability.[7] Likewise, a 2002 study conducted by the Department of Geophysics at Kyoto University attributes the generation of the ionotail on Venus to this same type of instability.[8]

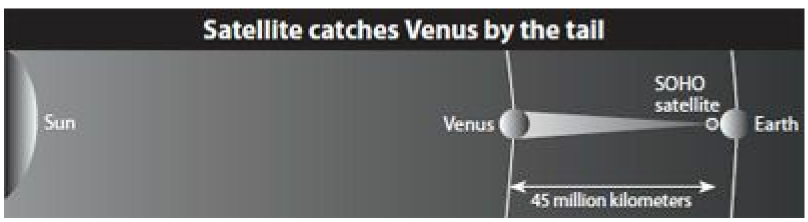

Figure 13.1. The ion tail of Venus. (Jeff Hecht, *New Scientist*, May 31, 1997)

More recent space probe data relating to the magnetosphere of Venus provide us with further validation for Velikovsky's view that Venus may have begun its life as a comet. This evidence relates to analysis of a plasma cloud that resides above the Venusian ionosphere, which was presented in an academic journal called *Geophysical Research Letters* in 1982. The article, titled "Magnetic Field and Plasma Wave Observations in a Plasma Cloud at Venus," states:

> Pioneer Venus magnetic field and plasma wave data are examined in a particularly clear example of a plasma cloud above the Venus ionosphere. The magnetic configuration is suggestive of acceleration of the plasma cloud by magnetic tension. This . . . suggests that plasma clouds do form a significant loss mechanism for the Venus ionosphere but do not necessarily indicate that the plasma cloud is detached from the ionosphere proper. The plasma cloud is accompanied by strong plasma

> wave activity and is significantly hotter than the ionospheric plasma encountered later on the same pass. We estimate a loss rate of the order of 2×10^{25} ions per second during this event. The geometry suggested by these observations is one of a ridge of dense cold plasma starting in the subsolar regions and flowing over the poles of the planet. Thus, these plasma clouds may be the planetary analogue of cometary tail rays.[9]

The question of whether a planet could possibly exhibit a true cometary tail was resolved in July 2010, when evidence of the first such planet was confirmed. The discovery was reported in *New Scientist* magazine:

> The gaseous extrasolar planet known as HD 209458b has been suspected of having a comet-like tail since 2003 but, being 153 light years away, it has been hard to prove. Using the Hubble Space Telescope, Jeffrey Linsky and his team at the University of Colorado in Boulder has managed to study the mass the planet is shedding. They calculated the tail's composition, direction and speed by studying changes in its host star's ultraviolet spectra as the planet passes in front of it. HD 209458b is similar to Jupiter in size and composition. It orbits its star in just 3.5 days and its surface is roughly 1100°C. This intense heat is causing heavy elements like carbon and silicon to boil off, and be blown away by the solar wind. "It's a very similar phenomenon to what happens with a comet," Linsky explains. "Except it's starting off as a gas planet as opposed to ice and the material in its outer atmosphere is being heated and lost. The wind from the star is pushing it away from the planet so we see a tail." The gas trail is blowing away from the star at more than 35,000 kilometres per hour. The team estimates that the comet-like planet has a trillion years before the entire planet disappears.[10]

Of course, the planet is not likely to actually disappear; as it continues to lose mass, its temperature will likely drop to a point at which it will no longer sustain the vaporization of its component elements.

The composition of this exoplanet is known to be similar to that of Jupiter, the reservoir from which Velikovsky proposes that Venus was ostensibly ejected. Its temperature at 1,100 degrees Celsius—hot enough to catalyze the ejection of its cometary tail—is only a little more than twice the current

surface temperature of Venus, at 460 degrees Celsius. Presumably, if Venus originated in Jupiter, as Velikovsky surmises, it was ejected at a substantially higher temperature, somewhere between the exceedingly hot temperature of Jupiter's core and the frigid temperature of its cloud tops. Furthermore, as we suggested in the previous chapter, current models of Venus, proposed as recently as September 2010, suggest that its "runaway greenhouse" atmosphere has actually created a situation in which the temperature of the planet has been cooling, very much as Velikovsky expected. An article at the Live Science website states, "It may seem downright bizarre, but a new model of Venus' superhot atmosphere suggests its greenhouse gases may actually be cooling the planet's interior. These gases initially cause Venus' temperature to rise, but at a certain threshold, they can trigger dynamic processes—which researchers call 'mobilization'—in the planet's crust that cool the mantle and overall surface temperature, researchers found."[11]

Velikovsky's notion that Jupiter could theoretically be the source of some short-period comets is supported by recent space missions that have afforded us the opportunity to examine material that composes actual comets. Based on these examinations, astronomers have come to new perspectives for understanding how the comets may have formed. This new evidence suggests that components of cometary material, rather than having formed in isolation somewhere deep in space, actually may have formed from primordial material under a variety of conditions, then intermixed sometime afterward. In 1999, NASA launched its Stardust spacecraft, which flew by the comet Wild 2 in 2004 and returned samples of cometary material to Earth in 2006. Speaking in regard to this mission, Warren E. Leary writes in a 2006 article for *Space and Cosmos*, "Comet dust seems to be a real zoo of things; we see all kinds of particles that are clearly formed at different places, possibly at different times and certainly under different conditions," said Scott Sandford of the NASA Ames Research Center in California, who was the lead author of one of the papers. Dr. Sandford said results of Stardust studies so far "all indicate that when the solar system was forming, there was a whole lot of mixing going on."[12]

A similar article, called "NASA's Greatest Mission? Stardust Finds Amino Acids, Keeps on Giving to Science," written in 2009 by Andrew Moseman and published in *Popular Mechanics*, states, "While most astronomers had

presumed comets formed at the far edge of the solar system, Stardust found compounds that form at hot temperatures near to the sun as well as organic compounds that form at cold temperatures away from the sun, meaning they might form in more peculiar ways than initially thought. “It’s a grab bag of the entire solar system,” Zolensky tells PM. Researchers are still grappling with the implications, trying to learn how materials like calcium aluminum formed near the sun could find their way to the outer solar system so quickly.[13]

A third article, written in 2006 and published by *Chemical & Engineering News,* titled “A Comet’s Chemical Composition,” quotes Carey M. Lisse of the Applied Physics Laboratory at Johns Hopkins University, who states, “One surprising observation is that comets contain a mixture of materials that form at widely varying temperatures. The finding suggests that the materials were created separately and somehow mixed together while forming a comet. . . . It’s really neat to see that the materials we find are all simple and what one would expect if you vaporized everything in the solar system today, then let it cool slowly, while stirring.”[14]

If we were to postulate, as traditional scientists do, that these comets formed billions of year ago from the material that existed within the primordial cloud, we would be left with the rather difficult prospect of explaining how so much varied material might have come together—after initial formation—from widespread parts of the universe, and by what unknown processes it might have come to be intermixed to produce a comet. On the other hand, if we were to postulate that these materials began their journey as part of the reserve of primordial material of a gas giant such as Jupiter, formed into diverse materials under the widely varying conditions that are known to exist at different levels within the Jovian atmosphere, and came to be intermixed with each other through the auspices of one of the gigantic storm vortices that perpetuate within that atmosphere, then many of the most difficult aspects of the mystery would simply go away. We would be left with the relatively more straightforward problem of how this cometary material came to be ejected from Jupiter. From this perspective, the orbits of short-period comets would be understood to make their typical close approach to Jupiter not because they have been captured by the giant planet, but rather because they originated there!

14

COULD THE ORBIT OF VENUS HAVE CIRCULARIZED SO QUICKLY?

As Velikovsky himself admitted, another major difficulty for his scenario lies with the question of how Venus, in the 3,000-some years since its ostensible encounter with Mars (following its purported close miss of Earth around 1500 BCE), could have reasonably circularized its orbit in such a short period of time, astronomically speaking. Without an answer to this question, it would be difficult to reconcile the Venus we know today with the comet Venus that Velikovsky describes.

Carl Sagan, in his address to the 1974 AAAS symposium in San Francisco, cited the circularization of the orbit of Venus among his likely arguments against Velikovsky. However, he also admitted that solutions to the very complex three-body problem in astronomy do not absolutely preclude Venus having done so. He said in regard to the probabilities against such quick circularization that “while the odds are large, they are not absolutely overwhelming.”[1] Likewise, there are comets, such as the comet Schwassmann-Wachmann, whose orbit falls between Jupiter and Saturn, that have attained circular orbits, although the time frame within which the circularization of orbit occurred is uncertain.[2]

In reviewing this issue ourselves, we realize on close consideration that the very same data that is offered to support the idea that Venus could have been out of its orbit also supports a view of Venus as having gone through a change in orbit. Each of the various ancient Venus tables, along with the conflicting data recorded for Venus by Ptolemy and Copernicus, presents a changeable picture regarding the position and motions of Venus—one that might well have been evolving over time.

Since the 1950s, scientists have come to realize that, under the right circumstances, the orbit of an astronomic body can circularize quite quickly, especially if there are gravitational or tidal resonances involved that can

affect its motion. After Venus made its theoretic close approach to Earth, the chances that it could have quickly established a circularized orbit increase if we postulate that tidal effects may have come significantly into play. Henry Spencer of the University of Toronto wrote in 1996, “Tidal effects have a strong tendency to circularize orbits. Even a moon that starts out in a highly elliptical orbit will end up in a circular orbit, unless it’s small and far out or a recent acquisition.”[3]

As part of his argument against Velikovsky’s postulated near collision between Venus and Earth, J. Derral Mulholland (also while participating in the 1974 AAAS symposium in San Francisco) actually invoked a claim that tidal forces are responsible for the rotational resonance between Venus and Earth. His statement, which is quoted in the book *Scientists Confront Velikovsky*, reads, “The spin of Mercury has been captured by the sun, while that of Venus has been captured by Earth. This latter, far from being evidence of a near-collision, is in fact evidence against it, because the present spin of Venus is linked with the present orbits of the two bodies by tidal friction.”[4]

A possibility left unconsidered by Mulholland is that Venus could have made a close approach to Earth, as Velikovsky claims, and then saw its orbit circularized by forces of tidal friction.

Based on Velikovsky’s scenario for the birth of Venus, there is another way to look at the question of the circularization of Venus’s orbit. From Velikovsky’s perspective, we might consider Venus to be a special case when we recall that Venus ostensibly began its life as a comet. An article for *Kronos* magazine by James M. McCanney titled “The Nature and Origin of Comets and the Evolution of Celestial Bodies” presents an alternate theory to explain the motion of comets, one that has been hotly disputed by some traditional astronomers. It states, “Comet wandering is well documented and is explained in the IBCM (Ice Ball Comet Model) as due to the ejection of vaporjets from the ice ball. The present theory explains wandering to be the result of variable tail drag, the same effect which causes the circularization of orbit.”[5]

Given these facts about Venus, its ostensible history as a comet, historical observations that it had a tail, and documented evidence of its ionotail, from McCanney’s view it would seem sensible to suggest that the ionotail could well be a remnant cometary tail of Venus, and as such, may have helped to

facilitate the quick circularization of the orbit of Venus the planet.

15

OBSERVATIONS ON THE NEW EVIDENCE

Some sixty years after its inception, it would be safe to say that the fierce controversy that erupted in 1950 over Immanuel Velikovsky's *Worlds in Collision* has largely abated. Now, one decade into the twenty-first century, many people who consider themselves to be casual students of astronomy may have never heard Immanuel Velikovsky's name. Of those who may still be aware of the controversy, many believe that Velikovsky's theories were disproved outright at the time of the 1974 AAAS symposium and so should no longer be thought to have any relevance.

Nevertheless, based on recent announcements, it seems that many modern-day astronomers still take care to avoid even mentioning Velikovsky's name, except when a finding seems to flatly contradict his theory. Those who find themselves in the position of having to report some new discovery that might possibly be interpreted as upholding Velikovsky's views often qualify their statements in ways that effectively distance the discovery from Velikovsky's theories. Sometimes efforts to circumvent the Velikovsky controversy have produced Monty Python–esque scenarios in which the very same researchers who have loudly denounced the slimness of evidence offered to support parts of Velikovsky's theory end up endorsing even-less-well-supported alternate theories. An example of this can be seen with the proposition of global resurfacing on Venus, whose scientific foundation so far seems to rest solely on "unknown geological forces." Similar "forces" have been conjured to explain the unexpectedly pristine surface of Jupiter's moon Io and so lead to the question of whether Io, too, might somehow possibly constitute a recently formed astronomic body.

Contrary to expectations that the Velikovsky controversy may have finally subsided, what we find when we take a closer look at the various questions posed by Velikovsky's theories is that we are still left with a fairly complex set of issues. First, there are a host of propositions made by Velikovsky that pertain to biblical events surrounding the Exodus from Egypt at around 1500

BCE, which may or may not hold up to scrutiny. Many of the effects cited by Velikovsky are reasonably explained as consequences of the eruption of Thera on Santorini. These include the presentation of what looked like a pillar of smoke or fire issuing from the volcano, volcanic ash that created lingering darkness, and a mechanism by which rivers might have temporarily turned red, large numbers of fish could have been killed, and vermin routed from their waterside habitats. As such, these do not require us to postulate planets to have been out of their orbits, although a terrestrial interpretation of these events may beg the question of what unusual circumstance may have catalyzed the most mammoth volcanic eruption on record.

Next, we have a number of what I would characterize as secondary biblical effects, such as edible manna that reportedly precipitated along with the morning dew. While the range of effects that might possibly have been unleashed on Earth as a result of passing through the cometary tail of Venus —at what distance or for what length of time—cannot be accurately determined, the rather vague chemistry offered up by Velikovsky to explain these can at best be called inadequate.

Likewise, it is understandable that researchers who work in the quantitative physical sciences might consider an ancient myth or text to be an unreliable source of information. One metaphor I often use to address this point involves asking the reader to imagine a group of fouryear-olds who witness the abduction of their day-care instructor and so are questioned by authorities. While it is undeniably true that the testimony of a four-year-old can be unreliable, we must also realize that, if four different four-year-olds were to all independently describe the perpetrator in matching terms—for example, if they each reported an abductor who was a tall, slim, red-haired man with a beard—then their descriptions would rise to the level of corroborated testimony. Based on this kind of corroborated testimony, regardless that it came from four-year olds, it would make sense for the police to begin searching for a tall, slim, red-haired man with a beard.

While it may not be fair to compare the observations of ancient astronomers to those of four-year olds, the basic principle remains the same: because the various ancient descriptions of Venus are provided by many different cultures from widespread regions of the globe, we can argue that they constitute corroborated testimony. As such, it would go against any

scientific method I know to arbitrarily set aside and effectively disregard that testimony. Likewise, if we were to ultimately conclude that Velikovsky's theories must be flatly wrong, it would still be incumbent on us to explore what might possibly have been happening with Venus in ancient times that could explain these widespread observations, which are clearly at odds with any normal planetary behavior that is familiar to us. For me, one very confusing aspect of the Velikovsky controversy is the apparent disinterest of traditional astronomers in pursuing and explaining this body of ancient descriptions, since clearly something of potential astronomic interest must have been occurring.

Another point of confusion comes out of the knowledge that many of the same researchers—archaeologists, geologists, historians, and researchers of ancient architecture—who have characterized ancient textual references as unreliable when used by Velikovsky also routinely employ these same ancient astronomic references to establish likely dates for ancient artifacts and events when working in their own fields of study. In those cases, ancient astronomers are routinely deemed to have been perfectly capable of accurately recording the date of an eclipse or the appearance of a new supernova, and their observations are often taken at face value.

There are aspects of Carl Sagan's response to the Velikovsky controversy that, in my view, have had a highly detrimental effect on the public discourse of scientific issues as it has come to be conducted in recent years. One of these comes out of what I see as a misapplication of the scientific rule of thumb called Occam's Razor. This guideline states that, when in doubt and with all other factors being equal, we should prefer the simpler of two theoretic explanations for a given problem. However, it seems in some cases that Sagan has taken this rule a step or two beyond its original application, making it his practice when attempting to refute a controversial theory to proactively formulate a second theory, unilaterally declare this second theory to be in some way "more likely" than the first theory, then, using Occam's Razor as implied justification, simply adopt his new theory. Inexplicably, Sagan seems to have considered this exercise to be the functional equivalent of having actually disproved the first theory based on evidence.

As for the rest of Velikovsky's scenario, it consists largely of events and propositions that have been categorically dismissed as flatly impossible by a

long list of prominent scientists, beginning with Albert Einstein. These declarations have often been accompanied by explicit calculations and/or derived probabilities that were intended by their authors to illustrate the gross infeasibility of Velikovsky's claims. Nonetheless, over time, it seems that virtually all of these scientists—including Einstein—eventually found themselves in the extremely awkward position of having to reverse, qualify, recast, reinterpret, or withdraw their original complaint against Velikovsky as, one by one, various seemingly impossible prospects proved themselves to be possible.

Moreover, during this same sixty-year period, our scientific investigations have inexplicably failed to turn up incontrovertible evidence of the several key points on which the Velikovsky controversy seems to turn—points whose definitive resolution would have the potential to immediately and directly disprove Velikovsky's theory. These include any fact that could categorically show Venus to be more than a few thousand years old, the documentation of any ancient reference prior to 1500 BCE that indisputably showed Venus to be a planet, the discovery of any ancient record of the risings and settings of Venus that closely agrees with modern sightings, or the uncovering of any ancient textual reference prior to 750 BCE that explicitly assigned 365 days to a solar year.

Meanwhile, as we have shown in the preceding chapters, much of the new scientific research since Velikovsky's death in 1979 seems to lend itself to interpretations that could potentially uphold Velikovsky's views. Likewise, several of the key events of Velikovsky's scenario that were loudly declaimed as wild imaginings at the time of their introduction are now overtly acknowledged to have likely occurred, although they are typically qualified so as to distance them in some important way from Velikovsky. To briefly recap the new evidence:

1. Because scientists consider the atmosphere of Jupiter to be a pristine sample of the primordial cloud, it now seems quite possible that a planet with the composition of Venus could have been formed from material that originated in Jupiter.
2. Recent models that were developed to explain the unexpectedly small size of Jupiter's core suggest that an event may have occurred that

would have been capable, according to Sagan's criteria, of ejecting Venus from Jupiter. Such an event would have vaporized the core of Jupiter and left it exceedingly hot, even today—twice the temperature of the core of Saturn. The preferred computer-modeled scenario for this event correlates well to the Greek myth on which Velikovsky bases his scenario for the "birth" of Venus and presumes that Jupiter effectively "swallowed" a large body just prior to ejecting Venus.

3. The Great Red Spot on Jupiter—the gigantic storm whose physics are not yet entirely understood by atmospheric scientists—provides one mechanism by which material from the interior of Jupiter could have been transported to Jupiter's surface prior to ejection.
4. Ancient astronomic records that have been uncovered and translated since Velikovsky published in 1950 refer to Venus using the same terms and descriptions cited in *Worlds in Collision*—terms that were traditionally applied to comets—and so seemingly uphold the credibility of Velikovsky's sources and the reasonableness of his translations.
5. Modern scholars who have reviewed the ancient Venus tables cited by Velikovsky agree that, even allowing for "background noise" such as scribal errors, there would be difficulties trying to correlate their data to modern sightings. Such discrepancies support Velikovsky's notion that Venus could have been out of its present orbit during ancient times.
6. Models that were developed to explain crustal damage on Mars allow that a single collision with a planetary-sized object of the sort proposed by Velikovsky could well have created the conditions that are known to exist on Mars. The main obstacle to this collision having happened in historically recent times is the preconceived belief on the part of astronomers that bodies of sufficient size have not roamed the solar system for millions of years.
7. Models that were developed to explain various facts about Venus, such as its lack of water, postulate that a major collision with a planet-sized object could also have created the conditions that are known to exist on Venus.
8. The apparent rotational resonance that exists between Venus and Earth allows for the possibility that the two planets could have come into close proximity with one another, as Velikovsky claims.

9. The eruption of Thera on the island of Santorini, around 1500 to 1600 BCE (the time Velikovsky claims Venus made a close approach to Earth) would have been seen from Egypt and could have produced many of the effects assigned to it by Velikovsky and reported in the biblical book of Exodus.
10. Significant changes in the global climate occurred around 750 BCE (the time Velikovsky claims Mars made a close approach to Earth), as evidenced in archeological finds, tree rings, and ice rings, and by known mass migrations. Likewise, there is evidence of major undefined geomagnetic events both at 1500 BCE and 750 BCE that caused great fluctuations in the magnetic field of Earth and that are associated by modern scientists with the same historical transitions claimed by Velikovsky. Because of the irregularities in the time frame of these occurrences, scientists believe they may have been precipitated by an unknown agent.
11. Close study of ancient Egyptian and Chinese evidence allows for the possibility that a 360-day year existed in ancient times, as Velikovsky claims. A uniform calendar revision from a 360day ancient year to a 365-day year was inexplicably made by many different, widespread cultures at around 750 BCE (the time Velikovsky claims that a close approach by Mars changed the orbit of Earth.) Likewise, significant cooling of Earth's climate is reported to have happened just following this proposed lengthening of the calendar year.
12. Some scientists attribute the rotational resonance of Venus and Earth to tidal forces. These same tidal forces provide one possible mechanism by which the orbit of Venus could theoretically have become circularized. Other researchers claim that variable drag caused by the tail of a comet is capable of circularizing its orbit.
13. Based on current observations, both Ptolemy and Copernicus seemingly miscalculated the timing of the risings and settings of Venus, and both apparently misportrayed the moonlike phases of Venus in drawings. These findings of Ptolemy and Copernicus are in disagreement both with each other and with modern sources. Taken together, they support the notion that Venus was out of its present orbit and that its orbit could, theoretically, have been changing as recently as 1500 CE.

14. Modern probes to Venus have documented attributes of the planet that could be consistent with a history as a comet. These include the discovery of hydroxyl ions, which are abundant in the atmosphere of comets but exceedingly rare in the atmospheres of planets, the existence of an ionotail, described by some astronomers as the planetary counterpart to a comet's tail, and evidence that the ionotail is driven by the Kelvin-Helmholtz Instability, the same effect that is thought to be responsible for a comet's tail.
15. Modern probes to Venus have affirmed several of Velikovsky's predictive claims for Venus and have documented unexpected attributes of Venus that could be consistent with a youthful planet. These include a surface temperature hot enough to melt lead and a high internal temperature, an unexpectedly small number of impact craters, a relatively pristine surface, evidence of active volcanic activity, a lack of continental plates, and confirmed evidence of a largely basalt crust in the absence of confirmed evidence of granite.
16. Many climatologists tacitly endorse the apparent youthfulness of Venus each time they cite some aspect of its geology or atmosphere as a reliable guide to what is likely to have been true during the Archean period on Earth.

Meanwhile, based on the presumption that Venus must be billions of years old, astronomers are also faced with a growing list of difficult questions relating to Venus and its formation that would largely disappear if evidence were to ultimately show that Venus must be a much younger planet. For example, questions of how and why the atmospheres of Venus and Earth evolved in such different ways largely disappear when approached from the perspective that Venus must be a young planet. In truth, the atmosphere of Venus can be said to be largely appropriate to a young, Earth-like planet. The search for a reasonable geologic cause for the apparent global resurfacing of Venus would become entirely unnecessary if we were to postulate that Venus is a young planet; no resurfacing agent would be required if we were to conclude that Venus exhibits the naturally pristine surface of a youthful astronomic body. The questions of why continental plates never formed on Venus and why evidence of granite on the surface of Venus has not been verified resolve themselves similarly if we reduce the length of the proposed

time frame within which they could have formed. The many direct comparisons made by atmospheric scientists between Venus and the Archean-period Earth would make sense if we were to postulate that Venus is a young planet.

If we step back from Venus and take a broader look at unresolved mysteries as they pertain to the formation of the solar system itself, it becomes clear that the prospect of a young Venus would carry with it an alternate view of how planets may form and an opportunity to potentially resolve many of the apparent contradictions that exist in modern planetary theory. Clearly, the many similarities that are known to exist between Venus and Earth strongly suggest that the two planets formed through similar processes. Imagine for a moment, based on evidence that we have actually seen in our search for extrasolar planets, that the typical rule for solar systems is that they form either with a pair of binary stars or as a single star and one or more gas giant planets that serve as great future reservoirs of primordial material. Then imagine that any additional planets, perhaps along with many short-term comets, are typically formed as a consequence of major cosmic impacts that are thought to occur from time to time with these gas giants. We may recall that this very concept—the idea that smaller astronomic bodies may be formed as a consequence of cosmic impacts—is one that is already firmly rooted in traditional astronomic theory because it is the most commonly accepted scenario for how our moon was formed. If it is reasonable to think that a moon can be produced by the impact of an asteroid or comet with a planet, then can it be less reasonable to suggest that a planet might possibly be the product of the more energetic impact of a larger astronomic body with a larger planet—or perhaps with the sun itself?

The idea that current evidence might support the notion that some of the planets in our solar system may have formed through expulsion from either a gas giant planet or a primordial gas giant protoplanet is supported by a recent article by interdisciplinary scientist J. Marvin Herndon. He writes the following in an article titled “Evidence Contrary to the Existing Exo-Planet Migration Concept.”

> The Earth’s core comprises about 32.5% by mass of the Earth as a whole. Only the enstatite chondrites, not the ordinary chondrites, have the sufficiently high proportion of iron-alloy that is observed for the core of

> the Earth. . . . The two main hypotheses about planetary formation, at very high pressures and at very low pressures, embody fundamentally different condensation processes which appear to be the underlying cause for the strikingly different states of oxidation of enstatite and carbonaceous chondrite matter. Matter like that of enstatite chondrites has the state of oxidation expected to have resulted from raining out at high temperatures and high pressures, whereas ordinary chondrites appear to have formed from a mix of those two types of matter. The extant standard model of solar system formation envisions condensation occurring at very low pressures, hence at low temperatures. Consequently, the state of oxidation would be like that of carbonaceous chondrites, having little or no metallic iron. Instead of the metal, iron would occur mainly as magnetite, Fe3O4. The standard model of solar system formation is wrong because it would lead to terrestrial planets having insufficiently massive cores. One is thus left with the idea of planets raining out from within a giant gaseous protoplanet, which appears to explain the high state of reduction observed for enstatite chondrites and for the Earth.[1]

If such a theory of planetary formation were true, then, in accordance with Sagan's requirement that processes that create large objects create more small objects, we should expect to observe a number of satellites for Jupiter that would correspond reasonably to the number of planets, which would themselves roughly represent the number of large historical impacts with Jupiter. In our solar system there are nine traditional planets, while Jupiter has sixty-three known moons or satellites. Likewise, if we are to believe that one of these planets—namely Venus—is a recent planet, then we should observe at least one satellite for Jupiter such as Io, whose pristine surface suggests that it, also, could be recently formed. This proposition is supported by evidence that Io remains volcanically active, as we might expect of a recently formed body. (In fact, Io is thought to be the most volcanically active body in the universe.)[2] Likewise, the nighttime temperature of Io has been found, unexpectedly, to vary little by latitude—support again for the notion that, as a young body, it still remains quite hot internally.[3] As additional support for this outlook on the possible formation of planets, it might be fair to note that some of Jupiter's moons, such as Ganymede, approach or actually exceed the size of the planet Mercury.

An article I read recently points out that most paradigm-changing discoveries in science in recent decades have been made by outsiders to the field. Perhaps this is because an outsider may feel less constrained to limit his or her thinking to the set of instructed possibilities that fall within the boundaries of accepted theory; perhaps, too, an outsider may be less cognizant of where the boundaries of accepted theory actually fall and so may unwittingly fail to observe them. More important, it may be true that the often rather sharp boundaries that have traditionally been drawn between various scientific fields of study actually do a disservice to the processes of discovery, that the cross-application of methodologies and perspectives from field to field might ultimately prove helpful. Furthermore, it is an outsider, someone who has both a fresh perspective and little at stake professionally, who may be most at liberty to pose significant, game-changing observations and who would be least impacted by subtle leverage from within a field that might otherwise have the effect of suppressing such observations.

Perhaps the greatest failing to be cited among the many critics of Immanuel Velikovsky would be their knee-jerk rush to publicly brand Velikovsky as a heretic, under circumstances in which all parties might have been better served if they had simply chosen to explore whether—and from what perspectives—Velikovsky's unorthodox views might make sense. It was the recognition of this ill-conceived approach that seems to have impressed itself on Albert Einstein during his final days and ultimately convinced him to extend the kinds of gentlemanly courtesies to Immanuel Velikovsky that one might reasonably expect between any two colleagues in science.

FOOTNOTE

1. The text is an expanded version of a letter that appeared in the Summer 1986 issue of *Skeptical Inquirer*, pp. 380–81. The writer was a former senior editor and executive secretary of the now defunct journal *Kronos*.

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About The Author

Laird Scranton is an independent software designer who became interested in Dogon mythology and symbolism in the early 1990s. He has studied ancient myth, language, and cosmology since 1997 and has been a lecturer at Colgate University. He also appears in John Anthony West's *Magical Egypt* DVD series. He lives in Albany, New York.

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